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VIEWS, NEWS AND INTERVIEWS.

An example of one kind of bunco game which electrical contractors meet in dealing with cities owning municipal electric lighting plants is afforded herewith: A certain city wanted to reconstruct a pole line running on about 300 poles. One clause of the specifications asked the bidders how much they would allow for each pole not used in reconstructing the line. The bidder who secured the contract, which amounted to a little over $3,000, agreed to allow $8 each for unused poles. After the contract was signed the city authorities went to the telephone company and secured permission to run the new line on the telephone poles. Then the contractor was instructed to build the new line on the telephone poles and the city put in a claim for an allowance of $8 each on 300 unused poles, or $2,400.

Policemen in uniform and the public generally are permitted to use the telephone pay stations in New York city free of charge to call an ambulance or a physician in case of an accident on the street.

Since the New York Electric Club disbanded the members of the metropolitan electrical fraternity have become a little scattered. The Hotel Imperial is now considered the up-town meeting place for electrical men in the evening, although a certain coterie may usually be found at Ferdinand's in Twenty-third street. At lunch time Nelson's café in Cortlandt street is the most popular rendezvous and quite a number of electrical workers may be found there every day from noon until 2 o'clock, and sometimes later. Now and then an occasional regret on the club's demise is expressed, but no one has as yet evinced the temerity to attempt to reorganize the old club or start a new one.

It is said that S. F. B. Morse, the inventor of the telegraph, who had beautiful hands, furnished Benjamin West, the painter, with the model for the hand of Christ in one of West's most famous compositions, and it is said that West had the hardihood to say to Morse that he might henceforth assert that he had a hand in the picture.

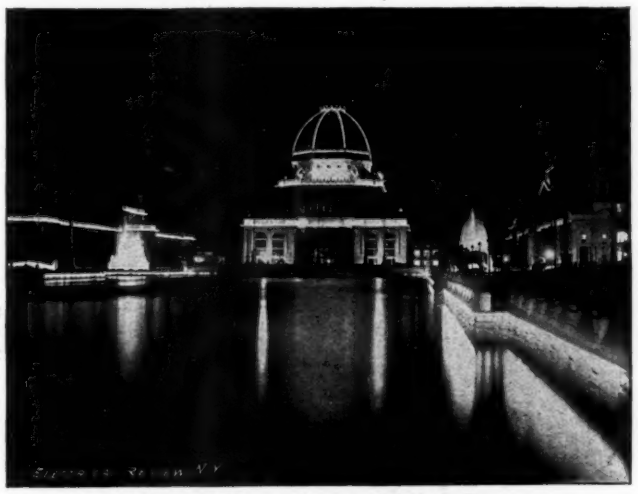
An investigation of the affairs of John Y. McKane, ex-Chief of Coney Island, now sojourning in Sing Sing prison, is bringing to light many peculiar developments. One of these is the fact that McKane selected the site for the electric light plant at Coney Island. He located it on a marsh next to his ice house, and sold the property to the town for a large sum of money. The contract was given to Henry Sturdevant, a Coney Island plumber, for $110,000. Just why McKane's requisition should call for $200,000 from the Common Lands Fund when the contract price was $90,000 less, is what the committee are anxious to find out. It is also claimed that payment on the drafts which McKane drew soon after work on the electric light plant was begun was stopped, and it is supposed that he used the money during the recent election in his efforts to defeat William J. Gaynor, candidate for the Supreme Court bench.

A singular aberration of the sidearms of marines on board English ships is reported. It appears that the bayonets belonging to the marines have, in many cases, become highly magnetized through contact with, or close proximity to, dynamos, and the result is that compasses have become affected by sentries passing near them when wearing these sidearms. An order has been issued that in future sentries are not to wear sidearms when on duty in the neighborhood of dynamos, and it is expected that this will overcome the difficulty.

There are explanations that don't explain, as many people have discovered, according to a daily paper. A gentleman, talking with a young lady, admitted that he had failed to keep abreast of the scientific progress of the age. "For instance," said he, "I don't understand how the incandescent light, now so extensively used, is procured." "Oh, it is very simple," said the lady, with the air of one who knows it all. "You just turn a button over the lamp, and the lights appear at once."

The Chicago Telephone girls have again achieved notoriety. The local manager of the main Chicago telephone exchange, who a year ago promulgated an edict that all girls employed in the Chicago exchange should uniformly dress in black, has just issued another order which reads something like this: "Hereafter the girls employed in the main office shall wear their skirts so they will clear the floor by three inches." The girls object, of course, but will doubtless obey the order as it is easier to cut off one's skirt than to cut off the source of one's supplies. Manager Tetu explains that this new move is to prevent the raising of dust in the office, which settles upon and impairs the working of the apparatus.

A correspondent of the Manchester, N. H., *Telegraph* writes from Florida over the signature of "Gen. Will Charlesyams" (which may be an alias for "Gen. Charles Williams"), and remarks that Manchester is the only city of 50,000 inhabitants in the United States without an electric railway, and that "the trolley system is dangerous, the storage system hasn't been developed yet and I want to give the public (be damned) something for a Spring bluff. Alligators are cheap down here and I have bought up a couple of hundred and shall have them shipped to Manchester soon. They are great crawlers and would no doubt enable superintendent Walker to run his cars on the 20 minute time right along."



ELECTRIC LIGHTING OF THE WORLD'S FAIR.

FROM A PHOTOGRAPH MADE AT NIGHT SHOWING THE GRAND LAGOON, THE ADMINISTRATION BUILDING AND THE ELECTRIC FOUNTAINS ILLUMINATED BY ELECTRIC LIGHT.

Telephoning from Dublin to Glasgow.

Telephonic communication already exists between Belfast, Ireland, and Glasgow, Scotland, a distance of 150 miles. A trunk line is now approaching completion between Dublin and Belfast, a distance of 105 miles. When completed communication between Dublin and Glasgow will be possible.

The Electric Lighting of the World's Fair.

AN INTERESTING AND WELL ATTENDED LECTURE DELIVERED BEFORE THE NEW YORK ELECTRICAL SOCIETY BY MR. T. C. MARTIN.

A lecture on the above subject was delivered at Columbia College on March 15 before the New York Electrical Society. The hall was crowded to its fullest capacity and the audience was most appreciative. The lecturer of the evening was Mr. T. C. Martin, who stated that he had had the active co-operation and assistance of Mr. Luther Stieringer, the consulting electrical engineer of the Fair, with whom he had been collecting illustrative material for some time, especially with the object of illustrating night effects with electrical illumination. They had collected such photographs, etc., on all sides, some of the most successful being those of Mr. Oscar H. Baldwin, who had charge of the fine Westinghouse exhibit at the Fair and who had used non-halation plates. The lecture was illustrated by about 100 slides, of which a large number were of night effects and scenery.

Mr. Martin recapitulated the main statistics of the magnitude of the Fair and its lighting, and contrasted them with those of New Orleans, Paris and other exhibitions. He went on to describe and depict the boiler plant, power plant, subways, etc., and then took up the various buildings, paying special attention to the Electricity Building, with its tower of light and scenic theatre. Then came Horticulture, Fine Arts and Liberal Arts, the latter with its great interior coronas and its four exterior search lights. Then a run was taken over to the Midway, with night and day views of the Ferris wheel, after which the circuit was made of the Woman's Building, Fisheries, Transportation, Mining, Agricultural, and thus to the Administration Building. In each case the individual and distinctive features of the lighting were described and quite freely illustrated. The Administration Building, inside and out, was very neatly handled, and then the Court of Honor was brought slowly into range by a fine series of views by night and day, with some of the effects of the search light. After looking at the court from the Lagoons, the Peristyle and Colonnade, Mr. Martin discussed the illumination of the court, pointing out its beauties and also the way in which it could have been enhanced in spectacular effect.

Attention was now concentrated on the Stieringer electric fountains, which were not only treated by the lecturer in a very poetical manner, much to the pleasure of the audience, but were, so to speak, taken apart, so that everybody could understand their mechanism and method of operation. Mr. Martin emphasized their value as a new and beau-

tiful amusement for city populations where ground was available for their display. The pumping station, the signaling tower and the inside of the fountains were all shown in detail, and then came a wonderful series of night views of the fountains in play. These literally brought down the house. Then came a beautiful finale with the court under colored lights; next in contrast was a moonlight view of the same scene, and the good night was a superb slide from a photograph taken on the last night of the search lights, when pointed at the Administration Building, and "with overarching swords of white flame they encrowned and paid it the parting salutation of electricity's homage."

Mr. Martin's descriptions were extremely felicitous and his delivery very good. The illustration on the first page of this issue of the ELECTRICAL REVIEW, which is reproduced from an amateur photograph by Mr. C. G. Hine, of New York, serves to show the character of Mr. Martin's lantern slides and one of the most beautiful results of the newest combination of electric light and photography.

Phillips Insulated Wire Company's New Factory.

The new factory of the Phillips Insulated Wire Company, at Darlington, a suburb of Pawtucket, R. I., is now completed, the machinery installed, and at last, after repeated removals, each time to more commodious quarters, they are settled in a factory of their own and are ready for business.

For a number of years past their product has been well known, and "O. K. Weather-proof" wire needs no introduction to the electrical fraternity. They have, during the past year, added a new wire to the list, and already "Ideal" insulated wire has been favorably received, and bids fair to occupy a field by itself for use where a high class of weather-proof is needed, either for a line wire or for inside wiring. This new "Ideal" wire was described in the columns of the ELECTRICAL REVIEW a few months ago in an able article by Mr. Chas. Cuttriss, and therefore needs no words of extended description, but we would state for the benefit of those who may not have read this descriptive article, that the new process consists in taking the raw cotton fiber and applying it as a tape to the wire, which process admits of a most thorough saturation by the insulating compound, the particles of cotton becoming matted into one solid envelope about the wire. Repeated tests of immersion have shown surprising results.

The new factory, which is illustrated herewith, is 186 by 50 feet, three stories and a basement, and is built entirely of brick with granite trimmings, with a large amount of window surface. The building affords an area of about 36,000 square feet of floor surface, and will be wholly devoted to the manufacture of their specialties.

The power plant consists of a 100 horse-power tubular boiler from the Bigelow works, New Haven, and a 60 horse power Green engine, built by the Providence Steam Engine Company. The building has been thoroughly equipped with steam heating apparatus, also with the Newton automatic fire extinguisher, while the plumbing cannot be surpassed in any building built for manufacturing purposes.

The offices are on the ground floor, in the northeast corner of the building, and are very light and cheerful, finished in hardwood and handsomely fitted up. The firm are thorough believers in electricity and its many applications, and have exemplified their belief by making use of it in many directions. They are about to install an electric plant capable of generating power for 200 incandescent lights, and it is needless to say that their "Ideal" wire will be used in connection with this installation.

Self-winding clocks are situated at each end of the building on each floor, and are connected electrically with a master clock in the office. A watchman's clock, made by the Eco Magnetic Clock Company, of Boston, is also located in the office, and connected with stations throughout the factory.

The new factory enjoys the best of freight facilities, the East Providence branch of the New York, New Haven & Hartford Railroad passing directly in the rear of the factory, and a spur track from it running to the shipping department. The company own considerable surrounding property, which is held in reserve for further building facilities if the necessity arises for still further enlarging their plant.

PHILLIPS INSULATED WIRE COMPANY'S NEW FACTORY AT DARLINGTON, R. I.

Dynamos and Motors—Direct.

A LECTURE AT COOPER UNION, NEW YORK, JANUARY 29, 1894, BEING AN EXTRACT FROM THE SECOND EDITION OF "PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS," BY F. B. CROCKER AND S. S. WHEELER, DELIVERED BY DR. S. S. WHEELER.

The subject of the evening is dynamos and motors for direct current. These machines depend on two principles discovered about 60 years ago, that a wire carrying a current is moved by a magnetic field, and that a wire moved through a magnetic field has a current generated in it. I will try to give you a little evidence of both of these phenomena in order that you may be impressed with the fact that they really do exist.

Here is an ordinary motor, the magnets of which I use to get a strong magnetic field. The armature has been removed so that I can put a plain coil of wire in place of it. An armature, of course, consists of a quantity of such coils. By putting a strong current through the field coils I make this space intensely magnetic. That is, there are a great many thousands of what we call lines of force passing from one pole of the magnet to the other. By placing a coil in this space and sending a current through it, the magnetic lines of force act on the current and cause a decided motion in the coil.

Now when I make contact with the end of this wire it will send the current through the coil and you will see that it is moved. It moves so as to have the coil take a flat position with respect to the magnetism that is passing across the space. The coil alone with the current through it has almost exactly the same effect as a magnet extending through its center. We are all familiar with the fact that if we put a piece of iron between the fields the current will cause it to swing around so as to react from one field to the other. We also know that if we wind some wire around such a piece of iron and send a current through it that it will make the iron magnetic. Consequently, we can readily see that a coil of wire alone can be regarded as a magnet, having its length in the direction through the center of the coil. That agrees with the position this coil takes when a current is passed through it. Now, the armature of a motor, which is a machine for producing motion from the current, consists simply of a number of coils like this wound together and provided with a shaft, so that the motion can be continuous; it has a commutator connected with the coils, so that as the coils pass the motion of the coils disconnects them from the brushes of the machine, so that they become dead and do not resist being moved further by the other active coils. As soon as a coil reaches the inactive position another coil in the armature at right angles to it is brought into the position where it would be moved on if the current were put through it. At the moment when the coil reaches this position the commutator connected with these coils sends the current through the other coils and removes it from this; so that the other coil is then made active and carries the motion further.

Now, suppose you have a number of coils moving in the field, and, instead of putting the current through them to produce the motion, you withdraw the current, you will find that their continuing motion generates a current in the coils, and it is a fact that these two phenomena are always co-existent. This, I think, is the most important thing about motor and dynamo work. There are many people who understand the machines pretty well who do not constantly bear that in mind, but it has more to do with the working of the machines than anything else.

We will change the connections of this coil now so that it is not connected to anything except this ampere meter, which, by the way, is an extremely sensitive one, so that you can see the amount of the current generated in the coil. Of course, the power of the coil is very feeble, being of so few turns; but to show its current we provide a very sensitive instrument, and we put a lamp behind the scale, so that you can all see the needle. There is no magnetism in the field now. I will put a current through the field, and now there is. You see the mere moving of this coil into and out of the field of magnetism causes a current to be generated in it.

You will notice that the needle moves forward when I withdraw the coil. If I reverse the coil the needle moves forward when I put it in, and recedes when I take it out, or, if it is put on the other field magnet, the motion is just the reverse.

I have here an armature for this machine which is not provided with the regular commutator for switching the coils into circuit as they revolve. The coils are brought out to two rings, so that, as the coils turn over, the armature revolving, the connection with each coil is the same all the time. The consequence is that we will be able to see a current generated as the coil turns over and then the current will cease for a moment, allowing the lamps to go out. Then, at the next half turn, the current will be generated again.

That is an alternating current. The alternating currents used for lighting are much more rapid than that, so that you cannot see the fluctuations. That is, probably, about 20 alternations a second, and several hundred are sometimes used. The currents that Mr. Tesla has been showing the world are as much more frequent in their alternations than the ordinary currents as these are slower. I brought this here with very slow alternation purposely, so that they would be slow enough to show in the flicker of the lamp. This machine, by the way, is a motor dynamo; that is, it has a motor armature on one end to drive it and an entirely separate armature on the other end to be used in generating currents. This particular

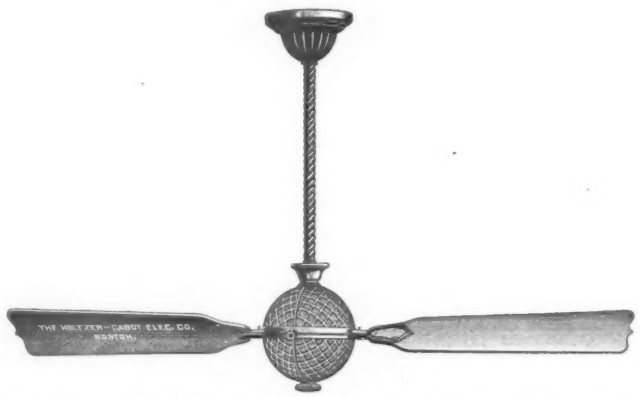


FIG. 1.—CEILING TYPE OF ALTERNATING AND DIRECT CURRENT HOLTZER-CABOT FAN MOTOR.

machine is rather interesting, because machines of this kind are coming into use very rapidly for ringing telephone bells, and that is why it is provided with the plain ring connections on one end, instead of what they call a rectifying commutator, so that the current as it comes off shall be alternating.

Now taking the plain armature, which consists of a quantity of such coils provided with a switch or commutator for bringing them into the circuit at the right moment, or a commutator, you will see when it is put in motion a current will be generated in it by this same cause, and if we take a motor which is running at full speed, in consequence of current being supplied to it, that same motion of the armature causes it to act as a dynamo, and when it is brought to full speed, the effect as a dynamo is to generate enough current flowing backward to counteract the current going in. In other words, when a motor is running free, the current required by it should be very small, and if you get a motor up to full speed and withdraw the current that is used to drive it, the withdrawal of the driving current will leave the current generated by it as a

dynamo apparent. This other machine is running as a motor from the power drawn from these wires, and the power is converted into momentum in the fly-wheel. The fly-wheel is put on to keep the machine in motion sometime after the driving current is taken away. I do that to show that after the current is turned off the fly wheel will keep the armature moving and cause it to generate current. Now, I have disconnected the wires and there is no power supplied to it at all, and yet the momentum of the fly-wheel keeping the armature going causes it to generate a current which you see in the lamps. That shows the reality of what we call the electro-motive force. These are the two principles which underlie all motors and dynamos. The machines should have various good qualities, they should be of ample strength and well proportioned, so that no part is liable to be broken or to be injured, and the heaviest part should be at the base so as to insure steadiness.

particular. All of the features about a machine that might be tested may be divided into 17 headings:

1. The adjustment and fit of parts.
2. Mechanical strength of parts against breaking or displacement.
3. Friction of bearings and brushes.
4. Balance of armature and pulley.
5. Noise.
6. Heating of commutator armature field magnets or bearings, etc.
7. Sparking at commutator.
8. Electrical resistance of conductors and of insulation of machine.
9. Line on circuit testing for conductivity, insulation, etc.
10. Voltage, electro-motive force drop or fall of potential.
11. Current in field and in armature, free and loaded.
12. Speed of armature, free and loaded.
13. Torque or pull, standing and running.
14. Power, electric and mechanical.
15. Efficiency, electrical and commercial.
16. Magnetism—total flux intensity—leakage and distribution.
17. Separation of losses.

The first few—adjustment and fit of parts, mechanical strength, friction of bearings, balance and noise—are matters of mere observation. They can hardly be measured quantitatively, but they should all be looked into, and a machine that is faulty in any one of these respects should not be tolerated.

The matter of the heating of the armature is very important, because it is the measure of the capacity of the machine. That is to say, a five horse-power motor can very easily deliver 10 horse-power, if it does not spark and get too hot. The only limit in the use of motors and dynamos, other than sparking, is the degree of heat that they are brought to by the work, and it is customary to specify the limit of heat. A fair limit might be 80 degrees Fahrenheit above the temperature of the room. But that is a matter that should always be tested in any dynamo or motor.

Sparking is very important and very serious if it exists, but it can hardly be measured as to quantity. No machine, except an arc dynamo, should spark perceptibly under ordinary loads. The best way to measure its sparking compared with any other machine is to gradually increase its load from nothing up to full load or an overload; in the meanwhile moving the brushes backward and forward so as to constantly find the point of least sparking, and a machine that is good for the work it is being used on should not spark until it has passed its full load. It ought really to be able to do 20 per cent. beyond its full load before sparking seriously.

(To be continued.)

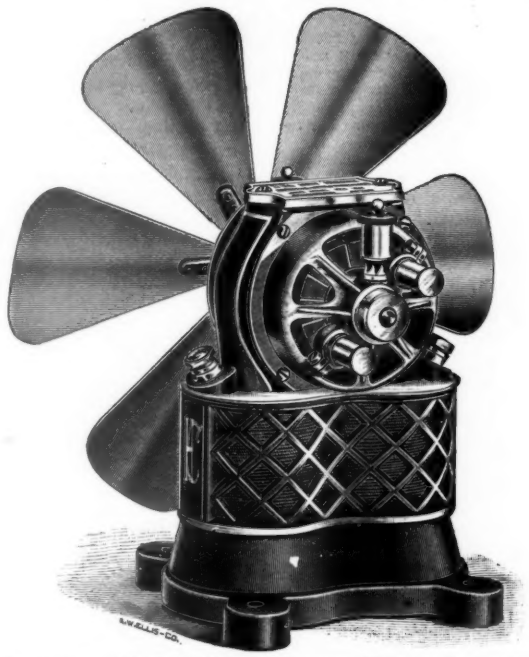


FIG. 2.—PATTERN M. O. O. DIRECT CURRENT HOLTZER-CABOT MOTOR.

FIG. 3.—ALTERNATING CURRENT HOLTZER-CABOT MOTOR WITH 12 INCH FAN.

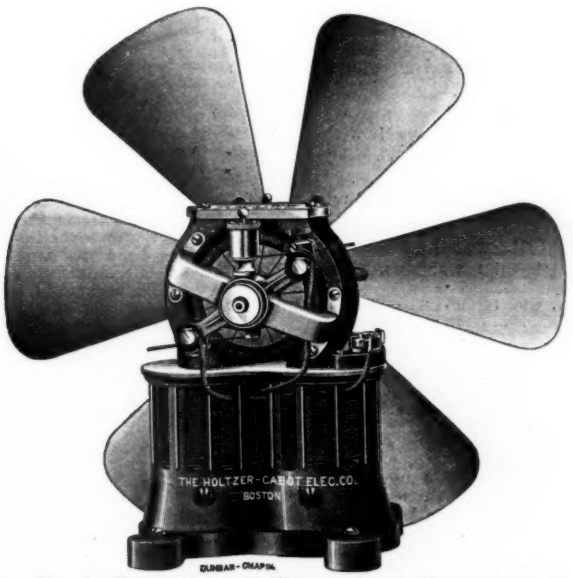


FIG. 4.—TRADE PATTERN HOLTZER-CABOT DIRECT CURRENT MOTOR.

As the regulation of a motor depends on the ability of the counter electro-motive force to keep the current from rushing through it too strongly, and not upon the resistance of the armature, a box of resistances is required to admit the current to the armature generally in starting up. Such a box for a five horse-power is on the floor. When the motor is brought up to speed the resistance should all be out of circuit, because the machine acting as a dynamo and sending the current back to the line to be able to keep the current from flowing into the armature in excess. But when the dynamo is standing still, if you do not have the resistance in circuit, an enormous current would flow into the armature and burn it out.

The testing of motors and dynamos is a very important branch of the business, and on it depends the ability to determine whether any machine is in good condition in every

Holtzer-Cabot Fan Motors.

The Holtzer-Cabot Electric Company, of Boston, Mass., are making preparations for a big trade in their well-known fan motors this Summer, and, in addition to their regular line, have a number of novelties which will be put on the market.

Most prominent among these are their new ceiling fans for both alternating and direct currents, for which they expect a large demand. Both are alike in general appearance and are a novelty, in that the latticed globe with blades attached is revolved by a friction pulley attached to the motor shaft.

In the alternating machine this globe revolves upon ball bearings, and the motor is economical in current consumption. Set at an angle of 22½ degrees, the blades make about 150 revolutions per minute at maximum speed. A switch at the base of the fan regulates the velocity as desired.

The Holtzer-Cabot company also manufacture a very complete line of alternating and direct-current fan motors with 12 or 15 inch blades, some of which are illustrated herewith. They are adapted to all voltages from 50 to 500 volts, and range in size from one-eighth to one-fourth horse-power.

Important improvements in the construction of their alternating motor have greatly increased its power, and a speed regulating device has also been added. The M. O. O. pattern, direct current, which met with universal favor and large sales last season, will be put on the market again this Summer. Recognizing the demand for a machine of this pattern, plain in finish, they have designed a motor preserving all the good points of the M. O. O. type, but without ornamentation.

A new edition of their general catalogue, containing a full description of all their apparatus, is about completed and will soon be ready for mailing.

OBITUARY.

Hon. Franklin J. Rollins, president of the Consolidated Electric Light Company, of Portland, Me., died on March 5 at his home in Portland.

George Louis Clary, for more than 10 years electrician at the Brattleboro, Mass., telephone exchange, and superintendent of the electric fire alarm service, died on March 3, after a distressing illness, from chronic rheumatism of nearly six months.

CONDUIT OWNERSHIP.

Shall the Local Companies, A Subway Company, or the Municipality Own the Wire Conduits?

ABSTRACT OF A PAPER BY CHAS. H. MORSE, INSPECTOR OF WIRES, CAMBRIDGE, MASS., BEFORE THE MASSACHUSETTS STREET SUPERINTENDENTS

It is, perhaps, unnecessary for me to dwell upon the dangers of overhead wires to you gentlemen who are so familiar with these dangers in your respective cities. You know that the wires are to quite an extent dangerous to life and property, and that they materially interfere with the workings of the fire department in our larger cities.

The question which we are to consider is whether it is reasonable to require the various companies to place their wires underground, and if reasonable who shall own the conduit in which they are placed? Is each company to own its own, or one company to construct the necessary conduit and lease space to the various companies? Or shall the municipalities assume the position of landlord?

In answer to the first question, as to whether it is reasonable to ask the company to bury its wires, allow me to say that the chief of the electrical bureau of the city of Chicago has repeatedly stated, over his signature, that the city of Chicago maintains 1,100 arc lamps of 2,000 candle-power each, which burn every night and all night, and that the cost does not exceed 19 cents per lamp per night. In this city every inch of this arc light city wire is underground in conduits owned and maintained by the city. Compare this with 40 cents per night, which is paid by the city of Boston for the same class of service with all the wire overhead, and I think the question of the economy of underground construction is settled.

The telephone company has acknowledged that it is better for them to bury wires by voluntarily doing the same; therefore, no argument is necessary for low tension wires. Fearing that some of you may not fully understand the conduits which have been constructed, you will pardon me if I take a few minutes of your time in explaining just what the conduit is.

Let your imagination picture to you a trench two and one-half feet wide and four feet deep, place in this a layer of concrete, made of one part cement and three parts finely cracked stone or gravel. On this bed lay three inch iron pipes or sheet-iron pipes lined with cement, or vitrified clay ducts, as many as may be required for the service. Then, every 400 feet imagine a brick chamber, five feet or more square and deep enough for a man to stand erect in. These covered with a large stone with a hole in the centre, provided with a heavy iron cover.

This system of tubes and manholes are now called conduits, into which wires may be drawn or removed at the pleasure of the owner.

The important question for us to consider is whether it is necessary that each company operating wires shall build its own subway, or whether all wires could be safely operated in one?

From the standpoint of superintendents of streets, I have no question you would unanimously vote for one conduit, if the same were practical. No one questions, for a moment, that it is perfectly safe to operate all kinds of telegraph and telephone wires, which are commonly called low tension wires, in one conduit. But when the question comes, can we safely place high tension wires in this same subway? a very important addition is made to the question. Theoretically, there are difficulties in the way. But, after years of practical success in the cities of New York, Chicago and Philadelphia, where the cities have low tension wires operating in the conduit with the high tension wires, it certainly seems that the theorist, who claims this cannot be done, must acknowledge that it is, practically, a success.

And, with your permission, I will read some letters and answers to questions from

representative electric men in each one of the cities mentioned a moment ago.

The following answers are for subways and wires owned and controlled by the city of Chicago, and do not include subways, manholes or cables owned and controlled by commercial corporations:

Q. Are your city wires, high and low tension, run in the same subway?

A. By low tension is meant telegraph or telephone wires. By high tension is meant electric light wires. Yes.

Q. About how many miles of low tension city wires have you underground?

A. Fire alarm, 34 miles of cable; police, etc., 550 miles of conductors; 183 miles of high tension electric light wires.

Q. Do the two classes of wires occupy the same manhole?

A. Yes.

Q. Have your low tension wires been burned off by electric light burn-outs in the manholes? How many times in the past two years?

A. Once in six years; were in the same duct.

Q. Are you troubled by explosions?

A. We have had two explosions in 10 years.

Q. Are the explosions supposed to be caused by electric light wires?

A. Neither of those were caused by electric light wires.

Q. Are your telephone wires disturbed by induction?

A. Yes, when grounded telephone circuits are used. No, when metallic telephone circuits are used.

Q. Do you consider it safe to have high and low tension wires in different ducts in the same subway, provided the system is small, say eight ducts?

A. Yes.

Q. Do you think it better to have one conduit and separate manholes?

A. One set of manholes will do, but the high and low tension wires should be kept apart, either by passing around opposite sides of the manholes or in separate compartments in suitably arranged manholes.

Q. Would you advise us to build two conduits, one on each side of the street?

A. I have not sufficient knowledge of the locality, requirements, etc., to advise.

D. M. HYLAND, Assistant Superintendent Fire Alarm Telegraph.

Your favor of the 15th received.

In the paper which I submitted and which was read before the Sixteenth Convention of the National Electric Light Association at St. Louis, March 1, 1893, which was published in the electrical papers at that time, is a statement of the troubles or faults of all kinds manifested in the operation of 750 miles of cable in New York city during 1892, which amounted in number of faults of all kinds to 49.

These faults of all kinds were classified under three heads:

"Low Tests."

"Grounds."

"Burn-outs."

"Burn-outs" were 14 in number, all told, on the 131 circuits in operation. It is not the rule that other wires than the one burned out are injured with it by the "burn-out."

This, I believe, answers your inquiry completely. Very truly yours,

WM. H. BROWN, Gen. Manager
United Electric Light and Power Co.
New York, February 17.

Copy of answers by E. A. Leslie, manager of Manhattan Electric Light Company, New York city.

Q. Do you have many burn-outs?

A. Very few.

Q. When these occur are the wires in the same duct other than the one burned out interfered with as a rule?

A. Rarely, and then only those immediately alongside.

Q. It has been claimed to us that a burn-out destroys all the wires in the manhole?

A. Not unless all are bunched together and are few in number. Have never heard of such a case.

February 15, 1894.

I have yours of the 12th instant, answer to which has been delayed owing to my absence from the city.

Regarding the placing of wires in subways occupied by the electric light currents, I beg to inform you that this department has placed its cables in many of the subways occupied by the electric light circuits, but of course in seperate and independent ducts. After two years of experience without accident or interference, I have no hesitation in continuing and extending the fire alarm service in these subways. To be sure care must be taken in placing them in the manholes, the only points at which any danger can arise.

I think you will have no difficulty in operating your telephones if the circuits are twisted pairs.

Very respectfully yours,
J. ELLIOT SMITH,
Supt. Fire Alarm Telegraph.
New York, January 22, 1894.

Q. Are your city wires—high and low tension—run in the same subway?

A. Yes.

Q. About how many miles of low tension wire (city) have you underground?

A. 599.

Q. Do the two classes of wires occupy the same manhole?

A. Yes.

Q. Have your low tension wires been burned off by burn-outs on the high tension wires?

A. No.

Q. Are you troubled by explosions?

A. None worth mentioning.

Q. Are your telephone wires disturbed by induction?

A. If grounded circuits, yes; if in twisted pairs, no.

Q. Do you consider it safe to have high and low tension wires in different ducts in the same subway.

A. Yes.

Q. Would you advise us to build two conduits, one on each side of the street?

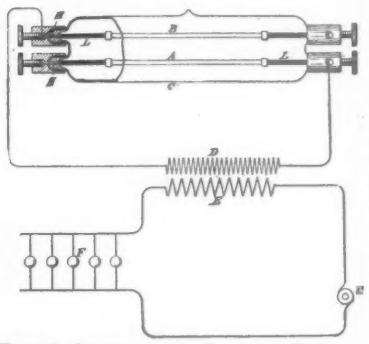
A. Entirely owing to conditions.

D. R. WALKER.
Philadelphia, February 16.

I feel justified in assuming that you are satisfied from this evidence that it is practical to operate all classes of wires in one subway, provided the subway is not excessively large.

You may, however, be interested to know what a man, who is acknowledged to be one of the first physicist in the country, thinks in relation to this matter.

President Harrison appointed a commission to consider the matter for the District of



TESLA'S ALTERNATING CURRENT METER.

Columbia. This commission had as one of its members, Professor Rowland, of Johns Hopkins University, and with your permission I will read from their report, which consists of 200 pages, their conclusions:

REPORT OF PRESIDENT HARRISON'S COMMISSION.

1. In cities overhead wires are objectionable.

2. Underground wires are practicable for all kinds of electrical service.

3. Efficient cables for all kinds of electrical service can be manufactured at reasonable cost. Failures of cables manufactured heretofore have been due to inferior material, faulty construction, or wrong methods of laying.

4. Conductors carrying high potential currents may be placed close to telephone or telegraph wires without interfering by induction. To prevent accident, it is well to place the high and low potential conductors in different ducts, and also to use separate manholes or compartments of manholes.

5. It is not advisable to limit the potential of currents. With proper precautions currents of the highest potential may safely be used.

6. Efficient management of electrical matters requires a permanent bureau or department, such as exists in Philadelphia and Chicago.

7. A single subway in the middle of the street is impracticable:

a. Because of its excessive cost.

b. Because it requires connections under the street to the property lines, and so does not do away with the cutting up and repairing of streets.

Where water, gas and sewer pipes are yet to be laid, a double subway might be practicable; that is, a tunnel on each side of the street under the sidewalk.

Where electric light wires alone are to be accommodated a system of conduit ducts and manholes on the "drawing in plan" is preferable.

8. As regards the ownership of the conduits, we believe that the interests of the city are best subserved by public ownership, and that the method of having them built by a subway company and renting them to the electric companies would result in great trouble and inconvenience to all concerned.

SUMMARY OF RECOMMENDATIONS.

1. We recommend the creation of a permanent electrical bureau to supervise all electrical work in the district, and to enforce all regulations relating thereto. Its duties should be:

To have charge of the fire alarm and police signal service.

To direct and supervise the construction of electrical conduits, the erection of poles, and placing of wires and all other appliances for electrical service by the district government, and to inspect the electrical appliances belonging to private individuals or corporations under permits or franchises.

To make periodical inspections and reports of all electrical appliances in the district.

The bureau should consist of a skilled electrician as chief, with a corps of competent assistants. Sufficient salary should be paid to secure first-class ability. We would recommend $4,000 per year for the chief of the bureau and $2,000 per annum for his principal assistant. Since efficiency will require special local and expert knowledge, both of which increase with length of service, the personnel of the bureau should be permanent as possible. Changes should be made for imperative reasons only.

2. We recommend that, within the limits indicated on the plans submitted, all wires should be put underground as soon as possible; and that the district commissioners be empowered to summarily remove poles and wires maintained overhead after due reasonable notice for their removal has been given.

3. We recommend the rectangular clay conduit, manufactured under the Lynch Lake patents, believing that it is best suited to the requirements of the district.

4. The telephone and electric light systems being practically underground already, we submit a plan for a conduit system sufficient to accommodate the telegraph, fire alarm and police signal lines of the city, and a reasonable extension of the telephone and electric light systems. The approximate cost of the system proposed will be $490,000.

5. We believe that all conduits should be owned by the city, and therefore recommend that hereafter all conduits and subways shall be constructed and maintained by the district government, under the direct supervision of the electrical bureau, and that the district government shall, as soon as practicable, acquire the ownership of those already constructed.

6. A reasonable rental should be charged for the use of conduits by franchised corporations or individuals. For the conduit above recommended we think that an annual charge of seven cents per foot per duct would be fair.

7. Should our recommendation as to the public ownership of conduits not be adopted, and should conduits still continue to be constructed by franchised corporations, we would recommend that the franchise of such corporations contain an express provision that one or more ducts on each line be reserved for free public use in addition to such other compensation as may be thought sufficient for the use of the public good. We further recommend that this provision be extended to the lines conditionally constructed during the past year, and, if possible, to all existing lines.

8. In those parts of the district where, for reasons of local expedience, overhead wires may be deemed admissible by the electrical bureau, we recommend that the poles be erected and owned by the district; and that rent, to be determined by the electrical bureau, shall be charged for their use.

Trusting that we have fully answered all the questions submitted to us, and that the plans and other data accompanying our report will as fully meet all the requirements as it is possible under the present conditions,

We are, very respectfully,

ANDREW ROSEWATER,
HENRY A. ROWLAND,
FRANCIS R. SHUNK, First Lieut. of Engineers,
} *Committee.*

After years of experience in the construction of subways, the mayor of the city of Philadelphia saw the importance of this measure, and in a report of 1890 urged upon the city the importance of municipal ownership of subways.

Professor Barrett, city electrician of the city of Chicago, who has had the largest experience in underground construction of any man in this country, is an advocate of municipal ownership of subways, and is positive in his assertion that it is perfectly safe and practicable to operate all kinds of wires in different ducts in the same subway.

It is but natural that each company should prefer to own its own conduits, as this gives to them franchise rights of great value, which are practically perpetual. And with the telephone companies the ownership of their conduits means, of course, the perpetuation of their monopoly, as at the expiration of their patents all the principal streets in our cities would be provided with telephone conduits and the people would not be willing to have the streets torn up for the admission of a competing company. If, however, the conduits were owned by the municipality or a conduit company space could be leased to individuals for private line instruments, and if thought best, to a competing telephone company. Therefore, I think you will readily see the motive which induces the telephone company to fight this proposition to the bitter end.

The question of municipal ownership of electric light plants is being vigorously discussed, and there is no doubt that many of our large cities will operate their own plants within a comparative few years. And it would be very much to their advantage to own the subways for their wires, and have a right to require the telephone and telegraph companies and the railway companies to operate their wires in this city subway at a fair rental. It is not the idea of the promoters of the bill which is now before the legislature to use this right as a means of taxation, but rather that the cities should build the subways and charge only enough rental to pay the interest on the money, the sinking fund and the cost of maintenance.

Thus, from an economic standpoint, we would all agree that for a medium sized conduit it would be better to have this joint occupancy, with separate manholes for high and low tension wires and only one trench.

As the citizens are to pay the interest on the money invested by all of these corporations, they have the right to demand that the work should be done in the most economic manner.

And as street men, I feel sure that I need not enlarge upon the advantages of municipal control of our streets, which under existing laws is gradually being taken away from the municipalities.

In conclusion, I would say that the question to be considered has resolved itself into one of three methods. Shall each company be allowed to construct its own subway? which would make in some streets in the city of Boston eight different subways, as i now the case in one street in Philadelphia; or shall the right be given to a corporation to construct one or two subways and lease space to the various companies? Or, shall the municipality, for the sake of the control of its own streets, construct these subways and lease space to the companies?

Tesla's Alternating Current Meter.

A novel meter for alternating currents, designed by Nikola Tesla, is illustrated in the accompanying diagram. The invention is based upon the fact that when a high tension discharge is made to pass from a conductor through rarefied gas, minute particles are thrown off from the conductor, the amount of detachment depending upon the strength of the current. In a suitable tube of glass are sealed platinum leading wires H coated inside the tube with insulating material. Sticks of carbon A, B are connected to these platinum terminals and the tube exhausted and sealed. The two carbon sticks A, B are electrically connected with the secondary of an induction coil, the primary of which is in series with the alternating circuit in which the current consumption is to be measured. For example, F represents a group of incandescent lamps, and E the primary of the induction coil. The difference of potential at the terminals of the secondary is proportionate to the primary current, and, therefore, to the current used by the lamps. The discharge from one conductor, A, to the other, as B, produces a detachment of infinitesimal particles along the entire length of the sticks, and after a period of service the latter increases in resistance. The amount of detachment is said to be proportional to the difference of potential between the two conductors. Hence, the increase of their resistance is in a definite proportion to the number of lamp hours. By measurements taken at the start and finish of any period of service the amount of energy used during such period of service may be computed. The action may be confined to confronting faces of the carbon sticks by coating the other faces with insulating material.

Bradley's New Polyphase Motors.

Polyphase motors, in which a rotary magnetic field is developed by the action of a plurality of alternating currents differing in phase, and is placed in inductive relation to a closed second circuit, promise to be liberally used as a source of power, both for large and small units. It is well understood that such motors dispense with the commutator required for direct-current machines, but it has been found that they do not operate efficiently without some provision for cutting down the strength of the secondary current when the motor is starting. The slip between the rotary poles and the secondary element is so great, when the motor is starting into action, that the induced current set up overpowers the poles of the rotary field, or, as it is phrased in shop parlance, "blows out the field." The provisions heretofore adopted for mitigating this effect and enabling the motor to start with strong torque have involved an external resistance or rheostat cut into the secondary circuit through the intermediation of brushes when the secondary element is the rotary element. The necessity for such a device is one of the drawbacks to the polyphase motor.

Mr. Charles S. Bradley, who, as is well-known, is a pioneer in this art, has devised several interesting types of polyphase motor in which this auxiliary resistance is dispensed with. In the accompanying engravings, Fig. 1 shows one of these forms, in which there are two rotary elements mounted on the same shaft and composed of a winding, technically known as the "squirrel cage" winding, comprising a series of copper or German silver bars led into longitudinal

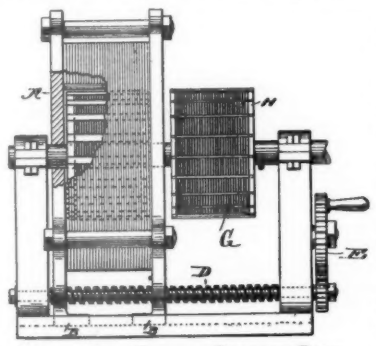


FIG. 1.—ONE FORM OF BRADLEY POLYPHASE MOTOR.

slots formed in the periphery of a laminated core and connected at the ends with a copper head. In one of these disks the bars may be formed of copper, and in the other of German silver or of copper of much smaller cross-section, so that its conducting capacity is considerably lower. In this way one of the secondary elements, as G, in the diagram, has a higher resistance than the other. The rotary field is mounted in sliding bearings and provided with gearing and a screw D for shifting it into co-operative relation to either of the secondary elements. When starting into action the field surrounds the element G, and after the motor has arrived at speed the field is gradually shifted until it encloses the element of lower resistance. Thus, the torque may be varied by shifting the field so as to embrace one or the other element, or to partly embrace both. Several forms of this machine have been designed, in one of which, especially applicable to small motors, the field may be quickly shifted by means of a hand lever.

Another type is illustrated in Figs. 2 and 3. In this case a single secondary element is used, but two rotary fields are provided, as indicated at A and B, the elements in which these fields are developed being stationary, as indicated in the drawing. The polarizing coils are wound upon internally projecting teeth, indicated at C, so as to develop in the ring core a rotary magnetic field when the windings are connected with a polyphase circuit. In inductive relation to the two cores is placed the secondary element D, which may be provided with independent laminated cores, as indicated in the engraving, or may have a single core embracing both field cores. Upon this element is placed a low resistance secondary circuit composed of longitudinal copper bars set in radial grooves formed in the laminæ and united at the ends by conducting plates as in the former type, thus forming a completely closed secondary circuit. When the poles of the rotary fields A and B occupy the same inductive position with relation to the secondary element, two electro-motive forces are set up in the parts of the secondary circuit embraced by the two fields, and if

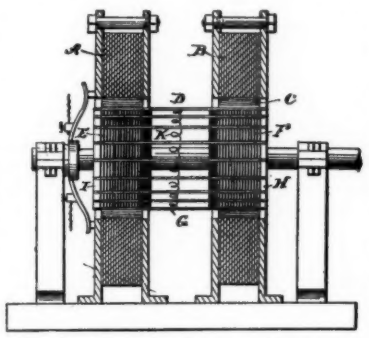


FIG. 2.—ANOTHER TYPE OF BRADLEY POLYPHASE MOTOR.

the electro-motive forces are in the same direction they co-operate on the secondary circuit. One of the fields, as A, is provided with a series of contact spots connected with different successive portions of the polarizing coil, and co-operating with these contact spots are three insulated contact brushes, as indicated in Fig. 3, provided with a handle L, by which the brushes may be circumferentially shifted. A triphase circuit may be led to the three brushes, and accordingly as the brushes are shifted over the series of contact spots, the poles developed in the element A will be given a definite amount of lead or lag over the poles developed in the element B, or may be made to coincide with the poles of B. If they coincide the two electro-motive forces act in series; if they are exactly opposite in phase the two electro-motive forces are squarely opposed, and the only path afforded the current is between the conducting bars and the rotary element by way of resistance wires K. Thus by a shifting of the brushes any desired amount of lead or lag may be given and more or less current may be shunted through the resistance K. Thus at starting the two electro-motive forces would be opposed to one another, and any current developed would have to flow through the high resistance path, thus giving the motor a maximum torque. After the motor has risen to speed, the handle L is shifted so as to bring the

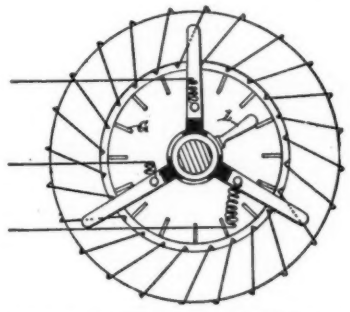


FIG. 3.—BRADLEY MOTOR SHOWING INSULATED CONTACT BRUSHES.

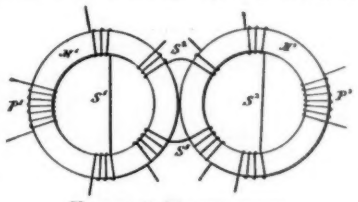
two electro-motive forces into unison, when current will flow from end to end of the secondary element and preserve the torque at high speeds. Instead of giving one rotary field a lead or lag over the other by means of the brushes, the field may be shifted bodily by a suitable mechanical arrangement, which obviously would produce the same electrical result, and this modification has also been worked out.

An Exhibition at Rome.

An International Exhibition of Fine Arts and Electricity is to be held in Rome, Italy, from the 20th of September, 1895, to the 30th of June, 1896. Applications for space should be made to the Executive Committee before the 30th of November next.

A Novel Transformer.

A novel transformer has been devised by Fred. S. Hunting, of Fort Wayne, Ind. A distinctive feature of this device is that several magnetic circuits are employed which are independently energized by two or more alternating currents differing in phase. The invention would be readily applicable to a quarter-phase circuit from which independent primaries would be led to the two magnetic circuits. The accompanying diagram clearly illustrates the idea involved. If P' and P^2 represent two primary circuits supplied respectively with alternating currents differing in phase, or disposed in any other suitable manner so that the fluctuating magnetic impulses developed in the cores M' and M^2 differ in time, then the secondary currents developed in circuits S' and S^2 will differ in time period. If other circuits, as S^3 and S^4, be so arranged that part of their convolutions will inclose one magnetic core and part another, there will be developed in these circuits a resultant current due to the combined action of both magnetic cores, and this current may be given any desired degree of phase displacement with reference to the current in primary coils P' or P^2 accordingly as the number of convolutions surrounding the respective cores is varied. For example, if, as is shown in circuit S^4, an equal number of convolutions is placed around each core, then there will be developed in circuit S^4 a resultant current having its phase half way between the phase of current in coils P' and P^2. If the number of convolutions



HUNTING'S TRANSFORMER.

on the two cores vary in the proportion as three is to two, and be joined together as indicated by the coils S^3, the resultant current produced by these coils will be closer in phase to the current flowing in P', providing the larger number of convolutions be placed as indicated in the diagram, upon the magnetic core controlled by coil P'. Thus, by varying the relative proportions of the two coils inclosing the two magnetic circuits, a resulting current of any desired phase displacement with reference to the phase of coils P' and P^2 may be developed. It will thus be seen that by means of two magnetic circuits or cores in which magneto-motive forces differing in phase are developed, we may produce any desired number of currents of differing phase and may produce a definite degree of phase displacement, and that the resultant current may in any case be shifted closer to the phase of magneto motive force in either core by increasing the inductive influence of said core upon the circuit carrying the resultant current.

An Important Decision on the Taxation of Corporations.

In the case of the People, *ex rel.*, the Edison Electric Illuminating Company, of New York, against Edward Wemple, Comptroller of the State, the Court of Appeals at Albany, N. Y., on March 6, gave a decision in favor of the company, the appeal being from an order of the General Term, third department, affirming the decision of the Comptroller and imposing certain taxes upon the company for the years 1886, 1887 and 1888. The opinion is by Judge Peckham, and all concur. The court holds that the company was not liable for the tax on capital stock during the years mentioned; that, despite the fact that its payment to the Comptroller of the amounts levied upon it were voluntary, it is entitled to a review of the proceedings levying the taxes, and that the amounts should be credited to current accounts of the company with the Comptroller's office. This reverses the General Term decision, which held that there was no remedy on account of the voluntary payments made. The amount involved was about $3,500.

Questions and Answers.

BY OUR "QUESTION EDITOR."

EFFECT OF CARBON BRUSHES ON THE COMMUTATOR.

TO THE EDITOR OF ELECTRICAL REVIEW:

Will you kindly explain to me why it is that carbon brushes do not wear away the commutator faster than copper ones? I know the cohesion of carbon is less than that of copper, but the molecules of carbon being one of the hardest substances known I fail to see why they do not cut deeply into the soft copper commutator.

Yours respectfully,

M. LOPEZ.

NEW YORK, February 28.

There are various reasons for this. The carbon brush having usually a very much greater surface of contact on the commutator does not need so much pressure. The slight quantity of lubricant used, together with the particles of metal, fill the pores of the carbon surface and glaze it. The carbon being substantially non-elastic maintains a fixed position, and once the curvature of the commutator is obtained, no disturbance of the relations occurs, whereas with metal brushes constant trimming is necessary, and every trimming requires a new setting, thus losing all benefit of previous conformation of surfaces. Again, the great thickness of the carbon brush, when worn to a fit on the commutator, gives it great stability mechanically, and vibration is therefore absent. The carbon brush has been a vital feature in the success of reversible motors, and on large generators of the railway and kindred types. We could not get along without it.

A MOTOR GENERATOR.

TO THE EDITOR OF ELECTRICAL REVIEW:

Will you tell me through your valuable columns what to do with a motor I have, to make it generate a current? It is one-eighth horse-power, runs 2,000 revolutions per minute, and the fields and armatures are wound for 110 volt circuit with No. 30 wire. I have had it speeded up to about 1,000 revolutions per minute and it will just generate enough current to taste it at the terminals.

AN OLD SUBSCRIBER.

KANSAS CITY, MO., February 19, 1894.

Without knowing all the data, simply say you can hardly expect much out of your motor for generating current unless you give it its full speed. The faster the speed (up to its critical point), the higher the electro-motive force, and with it the stronger becomes the field magnet. Bear in mind that the internal resistance must be overcome before you begin to get any considerable output. Speed it up to its normal rate of 2,000 revolutions per minute. If you don't get current proportionately, then there is something wrong with your circuit. Of course, you understand that a motor used as a generator and turning in the same direction gives out current of a reversed sign, and it must be seen that your current goes through the field coils so as to build up the magnetism.

LEAD POISONING.

TO THE EDITOR OF ELECTRICAL REVIEW:

Will you kindly let me know through your valuable paper if there is any danger of lead poisoning in the case of workmen in storage battery factories where they handle the moist oxide of lead paste, and particles of it float in the air as dust?

Yours respectfully,

STORAGE.

BALTIMORE, February 13, 1894.

It may be said that lead oxide might, in the course of time, and by constant handling, get into the system to a harmful extent. The result would be slow, but lead poisoning from manipulation of lead and its compounds is always slow in its manifestations. The particles of oxide floating in the air would quickly form basic carbonate of lead, but whether in that form or as the oxide the lungs would be likely to get a considerable quantity in the course of time, and eventually lead poisoning be produced. The workmen are not so liable to it from the mere handling of the oxide, as their hands become callous and not so liable to absorb the poison, and they usually know how to guard against any excess. Forced ventilation will keep the air comparatively clear of the poisonous particles.

The question of an electric road between Springfield and Urbana, O., is again being agitated.

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Our storage battery friends are able writers. The ELECTRICAL REVIEW now knows where to look for editors.

Cleveland, Ohio, seems to be the manufacturing Mecca these days. The Johnson rail company announces that it will build an immense factory there.

It begins to look as if we were to have real rapid transit in New York city, and that man of brains and progressive ideas, Hon. Abram S. Hewitt, will deserve the credit for it.

The self-winding electric clock is one of the inventions of value that seems never to have been appreciated. The ELECTRICAL REVIEW believes that every household would welcome this kind of a time-keeper. They are reliable, or certainly can be made so.

The condition of the telephone company must be very precarious when it cannot afford to give a directory free from advertisements to its subscribers.—*San Francisco Post.*

Is the condition of the *Post* so "precarious" that it can't publish its regular issues without advertisements?

THE TELEPHONE PATENT QUESTION.

A NUMBER OF IMPORTANT ONES.

TO THE EDITOR OF ELECTRICAL REVIEW:

Can you give me some data on the telephone situation, stating when the patents on the principal parts of the 'phone will be free? E. L. B.

Noblesville, Ind., March 12, 1894.

The two basic patents on the telephone, involving the method of magneto transmission and the magneto receiver, have expired, consequently anyone is free to use the telephone to that extent. For long distance work, however, the telephone business is not open to free public use. The American Bell Telephone Company owns a patent issued to Emile Berliner, November 17, 1891, which covers the familiar form of carbon transmitter. Such a transmitter has always been employed in long distance work. The magneto as ordinarily constructed has not sufficient power to traverse long distances and give commercial talk. Some modern types of magneto instruments have been devised which seem to possess the qualities for long distance use, but such instruments are the exception and not the rule.

There is some question as to whether the Berliner patent, above noted, will be sustained. The application was filed June 4, 1877, whereas the patent was not issued until 1891, lying fallow in the Patent Office for 14 years. There is a law suit pending, in which this patent is involved, which is being vigorously contested. We are unable to state what the issue will be.

A recent Supreme Court decision, in which the court held that a later patent issued, covering the subject matter clearly disclosed in a prior patent by the same inventor, is void *ab initio*, might be urged against the Berliner patent, for the reason that an instrument of the same construction was shown in a patent issued to Berliner in the early days of the telephone art. There are other patents owned by the Bell Telephone Company, granted to Thomas A. Edison, which cut an important figure in carbon transmission. It would be impossible to go into this subject minutely, except at great length.

For individual line service, that is, for short circuits and with only two stations involved, the art of telephony may now be considered as open to the public, but when a large number of co-operating subscribers are wanted a central station must be provided, and on this subject there are a great number of patents owned by the Bell company, which would have to be very carefully considered to avoid infringement.

Besides this, there are numerous patents on the ringing apparatus, involving magnetos and the automatic connections for calling a subscriber and cutting into and out of service his telephone. Among the important patents in this line may be noted the patents of Roosevelt, No. 215,837 of May 27, 1879; Gilliland, No. 242,195 of May 31, 1881; Watson, No. 270,522 of January 9, 1883; Phelps, No. 222,201 of December 2, 1879; Bergmann, No. 266,750 of October 31, 1882; Gilliland, No. 237,971 of February 22, 1881; and many later patents which bear more or less minutely on the subject. Most of the patents noted cover automatic means for switching the 'phone out and the bell into circuit when the apparatus is not in use. Various other contrivances, in order to avoid the broad patents on this subject involving an automatically actuated gravity switch, have been invented and patented. For example, Bergmann actuates the switch by a permanent magnet, which, when the telephone is on its support, draws contacts to their normal position and cuts in the telephone; Bartlett, No. 306,050, has a switch in the cord; Eckert, *et al*, No. 266,277, has keys on the 'phone, so that in handling the proper circuit changes will be made; and a number of others provide a mechanical arrangement which must necessarily be shifted before the telephone can be taken off its support.

Important patents which may be considered in looking up this subject are: Edison, Nos. 274,232, 474,230, 246,512, 250,250, 406,567, 485,311; Benjamin, No. 235,988; Eckert, *et al*, No. 313,409; Hinton, No. 378,250; Watson, Nos. 209,592, 265,897; Francis, No. 488,993; Lewis, Nos. 266,374, 266,295; Kellogg, No. 243,575; Cozzens, No. 258,894; Scribner, No. 248,671; Lyle, No. 309,791; Comstock, No. 319,789; and Turnbull, No. 338,889.

HERE AND THERE IN ELECTRICAL CIRCLES.

Improvements in electric elevators have made this field a very important one. It would be well for those interested to keep their eyes on Lieut. Frank J. Sprague.

It may be generally understood that E. H. Johnson knows what he is about When he announces a new electric railway conduit system ready for use, it should be a practical one.

A new electrical publication, with the extended name of *Electrical and Street Railway Reporter*, has made its appearance in neatly and clearly printed shape. It is published from 136 Liberty street, New York, and announces its staff to be Gilbert G. McDuff, general business manager; Newton Hall, assistant manager; and Geo. F. Porter, secretary and treasurer. The name of the editor—in some publications considered a necessary adjunct—is not given. The *E. a. S. R. R.* maps out a plan of active work, and will issue monthly. Its cover is red; if the hopes of the publishers are realized its contents will be.

The new Darrach street car fender is attracting deserved attention from electric railway and cable men.

The most artistic and complete electrical offices in this country are probably those formerly occupied by the General Electric Company at 173 and 175 Adams street, Chicago. These have just been secured by President George A. McKinlock, of the progressive Central Electric Company, of Chicago, who will move there May 1 next. The increase of business and demand for unequalled facilities that require this change on the part of the Central Electric gives trumpet-toned evidence of the extensive electrical patronage this house, by its able management, has secured. The ELECTRICAL REVIEW is pleased to note the success of this company, and it is thoroughly deserved.

The telephone patent record, published in another column, is of special interest at the present time.

The Heilmann Electric Locomotive.—Following on the success attending the recent trials of the Heilmann electric locomotive in France, comes the news that M. Heilmann is designing a still more powerful electric locomotive.

CORRESPONDENCE.

OUR BOSTON LETTER.

Mr. J. F. Bubert has succeeded Claflin & Kimball in the construction and engineering work of the Mather Electric Company, and has opened an office at 620 Atlantic avenue, Boston. Mr. Bubert has been closely identified with the Mather interests since 1884 and for the past seven years has had charge of the construction and engineering departments for Claflin & Kimball, formerly general agents of the Mather company. Mr. Bubert's long experience and undoubted ability in this most important branch of electrical work has eminently fitted him as an authority on the subject, and he is already being called upon to do considerable work as consulting engineer.

Judge Aldrich, of the United States Circuit Court, District of Massachusetts, has just rendered a decision in favor of Chas. W. Holtzer, of this city, in his suit against the Consolidated Electric Manufacturing Company for infringement of patent on construction of galvanic batteries. The battery, for the protection of which the suit was brought, is manufactured under Letters Patent No. 327,878, and is known as the "Holtzer Cylinder Battery." Judge Aldrich, in rendering his decision, says, in part:

"The complainant's invention must be accepted as a valuable improvement upon the means previously employed in this class of batteries. The device provides for a mechanical construction comprising practical utility and durability through simplified methods, and by means more satisfactory than any previously employed or known. That this invention is a useful improvement seems apparent from an examination of the complainant's claims and exhibits, in comparison with the claims set forth in prior patents and the batteries formerly used, as described in the evidence presented by the record. If there were doubt on the question we might well consider the fact that the complainant's idea of construction was readily adopted by the public generally, as well as by these defendants. It must, therefore, be found that the complainant's improvement involves patentable novelty, and that it was not anticipated by any form of construction previously known. Although the improvement is simple in its character, it is entitled to protection. Indeed, simplicity of construction is the leading characteristic of the Holtzer battery, and it is for the device which works this result that the complainant seeks protection. The defendant's battery appropriates the essential idea of construction contemplated by the first and second claims of complainant's patent, and is an infringement thereof. Let a decree be entered for an injunction and an accounting in accordance with the prayer."

Boston, March 17. H. G. T.

OUR WESTERN LETTER.

The Western Office of the ELECTRICAL REVIEW is removed from 565 to 463 The Rookery, the change being necessitated by the growth in business.

Where to Buy.—Experience has taught many a consumer the economy of purchasing supplies from the supply man rather than from the manufacturer. The former is better prepared to look after the interests of his customer, is brought into closer personal relation through a multiplicity of orders; shipments are made more promptly and better terms are secured both in the matter of prices and credits. A large supply house having an established reputation for fair dealing and satisfactory balance at the banks can usually purchase for spot cash at prices that enables it to sell at figures almost touching the cost of manufacture, and where the manufacturer would not dream of going. Never before has ready money proved so powerful a factor in the purchase of supplies as during the past few months. And it was through taking advantage of these conditions that Mr. George A. McKinlock has been able to so materially increase the volume of the business transacted by the Central Electric Company, under more favorable circumstances than ever before, and at prices that have proved satisfactory to buyer and seller. A visible manifestation of this growth in business is plainly shown in the necessity for greatly enlarged quarters and the leasing of the centrally located handsome warerooms and offices just vacated by the General Electric Company. These rooms are 50x175, affording ample floor space for all departments. F. DE L.

Chicago, March 17.

Don't Put too Many Electric Currents in One Conduit.

We publish on another page an abstract of a paper prepared by Mr. Charles H. Morse, of Cambridge, Mass. While all the conclusions of Mr. Morse may not meet with favor by the practical electrical men, the author is an able advocate of his side, and his paper is a valuable contribution to the literature on the subject.

The following article, touching some of these points and replying to the Boston *Herald* comments, appeared in a recent issue of that journal:

In a subway carrying lighting and power wires, hundreds and thousands of horse-power of electrical energy are imprisoned, and the rupture of the insulation of a cable may, at any moment, concentrate all this immense power at any point, resulting in the production of an electric furnace that would consume everything within reach. This is no imaginary danger, but it has actually occurred in New York several times, and if the city of Cambridge buries all its wires together, it will surely one day sacrifice its telegraph, telephone and lighting services to one of these electric disasters.

The weight of disinterested testimony of qualified witnesses was all against Mr. Morse's proposition. Professors Plympton and Raymond, of the electrical commission of Brooklyn, a city where a large amount of wire is underground, emphatically condemned the plan of placing all wires in the same conduit. My own testimony, based on long experience in New York, was to the same effect, In New York city the telephone company has more than 30,000 miles of wire underground, placed in conduits exclusively devoted to low tension service. In all those hundreds of miles of conduits there is not a foot of electric light or power wire of any sort. There are many manholes, where from 6,000 to 20,000 telephone wires concentrate, and the presence of a "high tension" wire in any one of those manholes would be a constant menace to the telephone service of the whole city.

The high and low tension subways in New York have always been separate, and their separation was made permanent some years ago by a resolution of the Board of Electrical Control, drafted in the light of experience then acquired. This resolution was confirmed by act of legislature, and the separation of high and low tension services has been rigidly maintained. The only exception that has been made to the rule in all the tens of thousands of miles of wire that lie under the streets of New York is the placing of three miles of fire alarm telegraph cable in a high tension subway. This was done because the fire department insisted on having a line along a street where there was no low tension subway, but it was done under the protest of the subway inspectors and engineers, in contravention of all rules, and entirely at the risk of the fire department. This is the solitary instance of high and low tension wires working in the same subway in New York.

There are very few electric wires that cannot be safely and advantageously buried to-day, but to bury all classes of wires in the same conduits would be to act contrary to all the experience that has been gained on the subject by years of troublesome and difficult work, and by vast expenditure of money. HERBERT LAWS WEBB.

March 8, 1894.

Another Incandescent Lamp Decision.

By a decision rendered on March 13, Judge Ricks, of Cleveland, Ohio, denied the motion of the Universal Electric Company to dissolve the existing injunction obtained against it by the Edison Electric Light Company, restraining the Universal company from infringing the Edison lamp patent. The Universal company moved to dissolve the injunction on the grounds that by reason of a certificate attached to the Edison lamp patent in 1883, which referred to certain foreign patents for the same invention, that patent expired with the English patent last November, or, at any rate, that the Edison company was estopped from contending that it did not then expire. Judge Ricks defeated the Universal company on both grounds, and the injunction against that company will continue in force.

A Timely Remembrance.

The ELECTRICAL REVIEW has received from the Okonite Company, Limited, 13 Park Row, New York, a very handsome clock, the case of which is glass with a bull's-eye over the face. The familiar okonite trade mark occupies the center of the face, the hours are printed in red, and "the best is always the cheapest" is forcefully prominent. Altogether, the clock is a most effective and tasteful advertisement.

PERSONAL.

Mr. John E. Ridall, of Pittsburgh, visited a few of his New York friends on Friday last.

Mr. D. D. Dickey, of the Faraday Carbon Company, Jeannette, Pa., was in New York last week.

Mr. J. W. Godfrey, of the New York Insulated Wire Company, is on his way to the Pacific Coast.

Mr. S. M. Hamill, of the Brush Electric Company, Cleveland, O., was among the visitors to New York last week.

Mr. Luther Stieringer started from New York last Thursday on a pleasure trip to California and the Midwinter Fair.

Mr. Eugene F. Phillips, president of the American Electrical Works, Providence, R. I., was in New York last week.

Mr. C. E. Bibber, of the Consolidated Electric Manufacturing Company, Boston, was in Philadelphia and New York last week.

Dr. W. M. Stine has returned to Chicago after a lengthy absence in Florida, and brings back the cheering news that there is fair hope of the ultimate restoration to health of his wife.

Mr. C. I. Hills, formerly with Claflin & Kimball, is now with the Columbia Incandescent Lamp Company, of St. Louis. Mr. Hills is known as one of the best lamp salesmen in the business.

Mr. J. Frank Morrison, of Baltimore, was in New York last week, and placed a number of orders. It is understood that Mr. Morrison has purchased the Southern Electric Company, of Baltimore, from the receiver.

Mr. W. C. McKinlock, secretary of the Metropolitan Electric Company, Chicago, reports business as being on the increase, having just returned from an extensive business trip with some good sized orders for the specialties handled by his company.

Mr. Henry M. Whitney says the report that he may again assume the presidency of the West End Street Railway Company, of Boston, is absolutely without foundation. Mr. Whitney has no desire for the office, and on the other hand the present directory is perfectly satisfied with the management as it now stands.

Mr. A. M. Young, of Waterbury, Conn., was a New York visitor last week. Mr. Young is actively interested in the management of a round dozen electric light and electric railway companies, and under his careful and practical supervision the companies are all succeeding, giving satisfaction to stockholder and patron alike.

Mr. C. O. Baker, Jr., the head of the great platinum house of Newark, N. J., returned last week from a trip to Buffalo, Toronto and Cleveland. He found a general improvement in business. At Toronto Mr. Baker had a pleasant visit with the newly elected vice-president of the National Electric Light Association, Mr. Frederic Nicholls, who bore his honors with blushing modesty and extended true Canadian hospitality to his distinguished visitor from the United States.

American Institute of Electrical Engineers.

At the regular monthly meeting of the council, held on February 21, associate members to the number of 19 were elected and five associates were transferred to full membership. These latter were the following: W. D. Sargent, Byron C. Wolverton, C. R. Van Trump, C. E. Gifford and J. R. Lovejoy.

The eighty-fifth meeting of the Institute will be held at headquarters, 12 West Thirty-first street, New York city, on Wednesday, March 21, at 8 P. M. A paper will be presented by Prof. Wm. A. Anthony, of Vineland, N. J., past president, "On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp." The discussion will be opened by Prof. W. Lispenard Robb, of Hartford, Conn.

For the convenience of western members, and in accordance with recent action taken by the Institute, a meeting of members residing in Chicago and vicinity will be held on the same date and hour at the Armour Institute, corner of Thirty-third street and Armour avenue, Chicago. Prof. D. C. Jackson, of Madison, Wis., has been invited to present the paper of Professor Anthony at Chicago, and Prof. B. F. Thomas, of Columbus, O., to open the discussion.

Wall Street and the Electrical Stock Market.

There is a decidedly more hopeful feeling in Wall street at this writing, and various prominent commission houses are advising their customers that the turn has come, and that the market is a buy on all reactions.

Western Union lost about 2 points up to Thursday on its quarterly statement, which, as prophesied by me, showed a deficit. It amounted to $378,735, which was the amount, less the dividend of 1¼ per cent., which was declared payable April 2. It was quite generally expected and, for the most part, was discounted. Wall street takes a very pessimistic view of the immediate future of this property, and is inclined to believe that the course of the stock will be downward rather than upward.

General Electric suffered a sharp reaction, the highest point being 44⅜ on Monday, the lowest 40¾ on Thursday and the last about 42¼. The decline was on realization sales of stock bought in the thirties. By some it was thought to be in discount of the annual report which is promised in a couple of weeks, and which, it is said, will handle the affairs of the company without gloves. The talk concerning this report is that it will show a large deficit and may possibly recommend the reduction of the capital. Withal it will be an excellent thing for the company, as it will enable shareholders to determine the exact status of their property. A director of the company was quoted during the week as stating that the earnings are between $600,000 and $700,000 per month.

The reason given for not paying the cumulative dividend on the preferred stock is that under the New York State laws there can be paid no dividend as long as there is an impairment of capital. There are three courses open to the company—either to reduce the stock outstanding the amount of the impairment, make up the impairment by subscribing fresh capital, or to wait until the assets have depreciated in value to the amount of capital outstanding. The common stock will have to stand the brunt of the impairment, as the preferred is a first lien upon the assets. The preferred stock during the week was steady at higher quotations than those which ruled last week, ranging between 74 and 75. The bonds also showed advances, ranging between 82 and 84.

The annual meeting of the company will be held at Schenectady at noon on April 10. Transfer books close March 17 and reopen April 11.

Wall street has considered with unusual interest the operations of the Cataract Electric Company, which appears to have secured an iron-clad franchise to distribute electrical current generated at Niagara Falls all over the State. The concensus of opinion is that instead of being a bad thing for the manufacturer of apparatus it will be a good thing, as it will develop the use of electrical apparatus to a very large degree. Those companies which will, of necessity, suffer, will be the lighting and power companies, as they will have to meet sharp competition. From this it would appear that General Electric sold its assets in certain of these companies in the nick of time.

Bell Telephone showed further strength this week, advancing from 174½ to 182. The latest advices from Boston are to the effect that the legislature will, in all probability, grant the increase of $30,000,000 in the capital stock without any objectionable conditions, such as selling the increased capital at public auction.

Dividends declared during the week not otherwise noted were: Edison Electric Illuminating, of Brooklyn, 1½ per cent., payable April 15; books close April 1, open April 15. American Bell Telephone, 3 per cent., payable April 16; books close April 1 and open April 14. The dividend of the Edison company, of Brooklyn, was increased ¼ per cent.

On the Boston Exchange Fort Wayne Electric was bid 3½ to 4; Westinghouse Electric, first preferred, 49 to 50; assenting, 32 to 32½.

Following is given a comparative table showing the prices of important electrical and telephone stock on March 16 and February 17:

Electrical.	March 16.	February 17.
Ed. Ill. of New York	95½- 97½	95 - 97
Ed. Ill. of Brooklyn	100 -101	99 -100
Ed. Ill. of Boston	110½-112	113¼-113¾
General Electric	41⅞- 42¼	35¾- 35¾
Edison Phonograph Toy	- 50¢	- 50¢
North American Phon.	2 - 3	3 - 4
Thom.-Hous. Sec. C.	4¼- 4¾	4¼- 4¾
Thom.-Hous. Sec. D.	4¾- 5	4⅛- 5
Thomp. Weld	- 50	- 50
Thomp. Eup. Weld	2 - 5	2 - 3
West. El. L. Con	31¾- 32	27 - 27¼
Western, preferred	49 - 50	45 - 46
Westinghouse, preferred	49 - 50	46 - 46½
Westinghouse, assenting	32 - 32½	27 - 27½
Telegraph and Telephone.		
American Bell	179½-180	171 -171½
Erie	33 - 36	42¼- 43
Hudson River	30½- 31¼	30¾- 31¼
Mexican	70¢ - 75¢	75¢ - 80¢
New York & New Jersey	96¼- 98	97¼- 98½
New England	49¾- 50	49 - 50
Tropical	- 10¢	- 10¢

New York, March 17. BAIN.

Notes of a Trip to the United States and to Chicago—1893.

READ BEFORE THE INSTITUTION OF ELECTRICAL ENGINEERS, LONDON, JANUARY 25, 1894, BY W. H. PREECE, C.B., F.R.S., PAST PRESIDENT.

(Continued from page 126.)

I have drawn up, with the assistance of the American Bell Telephone Company, a comparative statement showing the ratio between the subscribers and the population in 24 principal cities of the States. The details appear in the following tables:

CITY POPULATION COMPARED WITH CITY SUBSCRIBERS. COMPARATIVE STATEMENT JANUARY 1, 1893.

Twenty-four Cities.	Population.	Subscribers in Exchange.	Average No. of Inhabitants to Each Exch'ge Subscriber.
New York	1,515,301	9,066	167
Chicago	1,099,850	9,684	114
Philadelphia	1,046,964	3,620	289
Brooklyn	806,343	4,439	182
St. Louis	451,770	3,561	127
Boston	448,477	5,668*	79
Baltimore	434,439	2,116	205
Cincinnati and Covington	334,279	4,015	83
San Francisco	298,997	4,528	66
Cleveland	261,353	3,182	82
Buffalo	255,664	2,240	114
New Orleans	242,039	1,471	165
Pittsburgh	238,617	3,254	73
Washington	230,392	1,845	125
Detroit	205,876	4,287	48
Milwaukee	204,468	2,561	80
Newark	181,830	1,094	166
Minneapolis	164,738	2,053	80
Jersey City	163,003	970	166
Louisville	161,129	2,556	63
Kansas City	157,984	2,581	61
Omaha	140,452	1,738	81
St. Paul, Branch of Minneapolis	133,156	1,521	88
Providence	132,146	2,948	45

* Does not include express subscribers. With express, 72 inhabitants.

It will be seen how very much these places vary. In Providence, for instance, with a population of 132,146, we find one subscriber to each 45 persons; while in Philadelphia there is one to every 289 only.

In 10 of the principal towns of our own country the results are as follows:

	Population.	Subscribers in Exchange.	Average No. of Inhabitants to each Exch'ge Subscriber.
London	4,263,294	6,700	636.3
Liverpool	513,790	4,500	114.1
Manchester	510,998	2,300	222.1
Glasgow	669,059	3,200	209.0
Edinburgh	264,787	900	294.2
Plymouth	85,610	300	285.3
Birmingham	483,526	1,200	402.9
Leeds	375,540	1,300	288.8
Hull	204,750	400	511.8
Newcastle	192,305	1,300	147.8

The telephone in the United States is essential to the business man, and its price is compared with that of an office boy. Labor in the States is expensive, and an office boy costs more than a telephone subscription.

The present generation of America has grown up with the telephone. It has become a factor of business, and absolutely essential to the transaction of that business. Its use has passed its climax; it has reached its normal stage. There is no touting for business; business comes. Every new office must have it. The working is excellent, and they are alive to the necessity of maintaining its efficiency at the very highest point. Education is complete, not only of the staff, but of the customer. The apparatus itself is being perfected. Uniformity of practice is being introduced under the operation of the paternal control at Boston, and the influence of technical education and of technical institutions is being felt everywhere.

I find a group of highly educated, clever young electricians being engaged and encouraged by the telephone companies. New blood is being introduced, and great zeal and activity is shown.

III.—THE ELECTRICAL CONGRESS.

Two Congresses were held at Chicago—the one, a general one, to which all electricians were invited; and the other, called "The Chamber of Delegates," to which nominees from the different governments were sent. The latter was the more important of the two, but each secured considerable attention, and they were distinctly great successes. The following extract from an American technical journal very fairly summarizes the results:—

The Chicago Congress.

"The much-talked-of International Electrical Congress is now a thing of the past. Its record may be briefly summarized by saying that the attendance was good; that it was truly international; that there were just about enough papers; that some good work was done; that the social features were enjoyable; and that, while the general management left much to be desired, the Congress itself was a success—not quite as grand a success as we should like to have seen, but, nevertheless, a success. Among the papers read were a few which created unusual interest, and some which will, doubtless, become standards of reference. The papers and discussions were of such a character that the published volume of the proceedings will be interesting reading, and will become a book of reference. The foreign attendance was such that the Congress became truly an international one. Among the foreign countries represented England took the lead in numbers, and especially in papers read, and in the discussions. Germany and France came next. That it was an international assembly was shown by the fact that the French language was freely used in papers and discussions, the only reason why German was not used being that educated natives of that country almost always understand and speak English. Thanks to a few energetic, experienced and willing members and exhibitors, the social features were not entirely omitted. The social events that did take place were enjoyable, and will be long remembered by those who took part."

The Congress met on August 21, at least 500 being present.

Professor von Helmholtz was appointed honorary president, Professor Elisha Gray, chairman.

Each principal European country had a vice-president, and I had the honor of being selected to represent England.

The Congress was divided into three sections: *a*, Pure theory; *b*, theory and practice; *c*, pure practice.

Some excellent papers were read, and good discussions ensued.

The most prominent subjects dealt with were the transmission of power to great distances, and general preference was shown for alternating current systems. The work being done at Niagara excited general interest, and some of us visited these works afterwards, with great profit and pleasure.

Professor Ayrton read a very able paper on the variation of arc lamps, so much used in America; while much interest was created by the reading of a paper by Professor Silvanus Thompson on "Ocean Telephony," a possibility in the future. My paper on "Signaling through Space" also created much interest.

Perhaps the most useful result of the Congress was the bringing together of such an international mixture of electricians, making friendships, allaying jealousies and breaking down national prejudices. Electricity is the only branch of science which has but one language, and it is now quite cosmical in its character.

Congresses do infinite good in promoting friendliness among nations.

Chamber of Delegates.

The object of this meeting was really to consummate the work done by the British Association and by the Board of Trade, and to secure the official sanction of the United States government to the units selected and adopted in England. This was done, and the report of the Chamber gives international support to the proposed legalization of the ohm, volt, farad, ampere, watt, and joule, as defined by the committee of the Board of Trade. There is no doubt that all European governments will now accept these decisions.

A new unit was adopted, viz., the "henry," a unit of induction, which was sometimes called the "quadrant," as defined in Paris in 1889, and sometimes the "sechom," as proposed in England. The acceptance of the name "henry" pleased the Americans very much, for their nationality has hitherto been unrepresented among the celebrated electricians whose names have been applied to the standards of electrical measurements. Germany, Italy, France were represented by Ohm, Volta, Coulomb, and Ampere; while England absorbed no less than three, viz., Faraday, Watt, and Joule. America has now her Henry, and is satisfied.

The following is the official report of the resolutions arrived at:

"*Resolved*, That the several governments represented by the delegates of this International Congress of Electricians be and they are hereby recommended to formally adopt as legal units of electrical measure the following: As a unit of resistance the *international ohm*, which is based upon the ohm equal to 10^9 units of resistance of the C. G. S. system of electro-magnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14.4521 grammes in mass, of a constant cross-sectional area, and of the length of 106.3 centimeters.

"As a unit of current the *international ampere*, which is one-tenth of the unit of current of the C. G. S. system of electro-magnetic units, and which is represented sufficiently well for practical use by the unvarying current which, when passed through a solution of nitrate of silver in water, and in accordance with accompanying specifications, deposits silver at the rate of 0.001118 of a gramme per second.

"As a unit of electro-motive force the *international volt*, which is the electro-motive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere, and which is represented sufficiently well for practical use by $\frac{1000}{1434}$ of the electro-motive force between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of 15 degrees C., and prepared in the manner described in the accompanying specification.

"As a unit of quantity, the *international coulomb*, which is the quantity of electricity transferred by a current of one international ampere in one second.

"As a unit of capacity, the *international farad*, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity.

"As a unit of work, the *joule*, which is equal to 10^7 units of work in the C. G. S. system, and which is represented sufficiently well for practical use by the energy expended in one second by an international ampere in an international ohm.

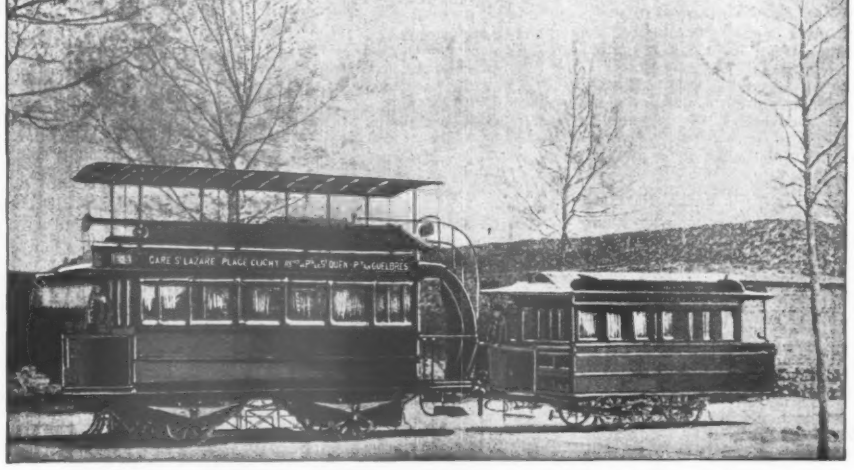
"As a unit of power, the *watt*, which is equal to 10^7 units of power in the C. G. S. system, and which is represented sufficiently well for practical use by the work done at the rate of one joule per second.

"As the unit of induction, the *henry*, which is the induction in a circuit when the electro-motive force induced in this circuit is one international volt, while the inducing current varies at the rate of one ampere per second.

"The Chamber also voted that it was not wise to adopt or recommend a standard of light at the present time."

An attempt was made to introduce other units, but the feeling is pretty strong that language-framing electricians must rest on their oars for a time. New ideas and new measurements must have new terms and new names, but the general public must become more accustomed to the new language already invented before proceeding to manufacture more novelties in phraseology. The new terms are even now very difficult to explain, and still more difficult to understand. Moreover, electricians themselves are not sufficiently unanimous either as to the necessity or upon the accuracy of the definitions of the new conditions, and therefore they can afford to wait for a final settlement for another congress some years hence — perhaps in Paris in 1900.

(To be continued.)



STORAGE BATTERY CAR WITH TRAILER, AT PARIS, FRANCE, EQUIPPED WITH CHLORIDE ACCUMULATORS.

The Chloride Accumulator Street Railway System.

The operation of street railways by current obtained from accumulators is gradually approaching the state of practical usefulness. One of the principal drawbacks consists in the fact that the accumulators themselves must be carried, and it would seem, as a rural friend once put it, "Looks mighty like yer wuz pulling yerself along by yer bootstraps." Nevertheless, improvements are being made, and one of the most recent is the so-called chloride accumulator.

The largest installation in the world for operating street cars by accumulators is that in Paris, France, where about 25 cars are now in service, and the company operating them declare that the line will be equipped, in the near future, with an additional 50 cars. We reproduce, herewith, an illustration showing a car with trailer on the Paris road.

The chloride accumulator, which is used in this installation, is, in this country, manufactured by the Electric Storage Battery Company, of Philadelphia. A few facts connected with the operation of this line will no doubt prove of much interest.

The installation of the St. Denis station has been made in view of the development of two lines, each about six miles in length, extending from the rond-pont de Picardic at St. Denis, the one to the Madeleine and the other to the Opera. The first trials date from February, 1892. Horse cars have been done away with on the line to the Madeleine, and a third line running from St. Ouen to Neuilly will soon be operated by electric cars. Here the daily mileage of each car is to be at least 65 miles, and the weight of the cars, including all accessories, must not exceed 6,000 pounds.

The accumulators, which are of the chloride type, are placed under the seats of the car. There are 108 cells of 11 plates each contained in hard rubber boxes, the plates being $7\frac{3}{4}''$x$7\frac{3}{4}''$x$\frac{1}{4}''$, the total weight of the cell being $38\frac{1}{2}$ pounds.

These batteries are divided into 12 groups of nine batteries each, contained in 12 wooden boxes, six on each side of the car, the batteries of each group being connected in series and the two terminals attached to copper strips fastened to one of the partitions of the wooden box. The station for accumulators has space for 24 sets of batteries, each one connected to a distributing switchboard by a special circuit in which is an ammeter, an indicator of the direction of the current, a double-pole circuit breaker and a make-and-break switch. The changing of the batteries is effected by means of small cars onto which the batteries are slid.

Experiments have shown that the duration of the charge is six hours for a battery which has furnished all its capacity of 230 ampere hours or 52 horse-power hours.

The daily service in the Madeleine route (the only one at present entirely operated by electric cars) consists of 104 trips. Seven cars are operated on this line, some making about 90 or 100 miles, while horse-cars make not much more than 60 miles. The running time between terminals is 55 minutes, including stops.

The weight of a full car is about 29,000 pounds, of which 5,700 pounds are for the batteries and their accessories and 7,700 pounds for the passengers.

The mean tractile force is about $26\frac{1}{4}$ pounds per ton.

Electrical Measurements.

A LECTURE DELIVERED AT COOPER UNION, FEBRUARY 5, 1894.

BY A. E. KENNELLY.

(*Continued from page 103.*)

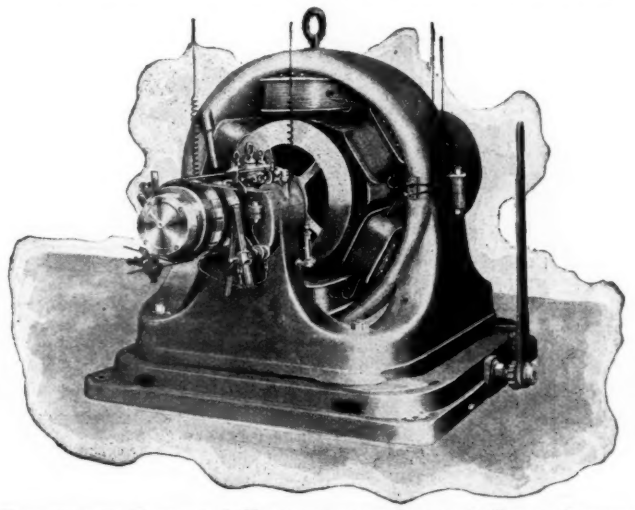
Now we have seen how resistance and pressure are measured. From those two things alone you can always tell current, because when you set to work a pressure of one volt to work through one ohm, if you join those wires in such a way that the one volt pressure is working through that one ohm, you will get one unit of current, and the unit of current is called the ampere. You will get one ampere when you set that cell of one volt to work upon that ohm, assuming of course that there is no resistance in the cell. That is strictly not so, really, for there is resistance in the cell; but we may assume that it has none for the time being. Once having determined the total amount of pressure as volts in your circuit, and the total amount as ohms of resistance in your circuit, you would be in position to say just what amount of current passed through it by dividing the latter into the former, but the galvanometers themselves will, if they are properly marked off, show what the current is. Here is a galvanometer which simply moves when a current passes through it. It is marked off in degrees, but that does not tell you how many amperes are passing through it. You can find out by passing a measured number of amperes through it; you could calibrate it in fact, and then it would be a current measurer in the sense of being an ampere meter. But there are a number of such instruments which do give you immediately the amount of current which passes through them, by means of a needle pointing on a scale. Here, for instance, is a Weston instrument which has two terminals at the side, arranged in such a way that when you connect these in any circuit or conductor carrying a current the needle will move over a scale and mirror, and will stop at a certain point with a number attached to it, showing the number of amperes that are passing through the circuit at that time. It is nothing more than a particular kind of portable galvanometer, so arranged that the index will mark off the strength of the current passing through the instrument. The number of amperes which pass through a circuit will tell you immediately the pressure on the circuit if you know the resistance, because by Ohm's law you simply divide the pressure by the resistance to get the current. This lamp here, for example, takes about one-half an ampere. The pressure on this circuit is shown by the voltmeter, the needle of which at this moment registers 119 volts. The pressure on the system is 119 volts, and as you throw every lamp into play that 119 volts of pressure forces through each lamp about one-half an ampere. That means a resistance of 238 ohms to each lamp. If we put on some of these lamps now, this ampere meter will tell us how many amperes are flowing, and you will see that about two lamps go to each ampere. It now shows about two amperes, and there are about four lamps. It is now about eight amperes, which is about 16 lamps. So that every lamp represents about one-half an ampere when operated at a pressure of about 120. This instrument, you see, gives you not only the amount of current, but it enables you to find out immediately what the resistance of each lamp is so soon as you know that the pressure is 120 volts.

Our next step will be to show you how we measure power. When you lift a heavy weight you know that you are doing work, and if you run upstairs pretty rapidly you are conscious of doing work, and the faster you run up, of course, the more rapidly you are working and your activity is greater. It is a very difficult matter to measure the amount of work done by machines unless you have quite a considerable amount of apparatus at your command. When you have a steam engine, for example, and it is driving a lathe through a set of shafts and belting, it is not easy to guess, unless you have some experience, how much work that machine is giving out and how it varies when you put the load on the lathe, or how much work the shaft is doing. But it so happens, and it fortunately happens, that if you have any electrical generators or motors which are driving that lathe or driving the shaft you can very easily and very accurately determine the amount of power that you are employing. Electricity, fortunately, gives you, with great convenience and simplicity, the amount of power which you are employing, and that is one of the advantages that people find who employ electric motors. They put a motor in their building, say, for running their lathes or running their elevator, and they generally, unless forewarned, commence by putting in a motor that is unnecessarily large. They have over-estimated the amount of power that they are employing, and so soon as they get their motor in and see its performance electrically, they see, from the electrical measurements that the power they are employing is less than they supposed it would be. It is perfectly evident that this lamp represents a certain amount of power. The fact that we have that lamp burning means that there is more steam going into a certain engine in this city, up-town or in Pearl street; that the stoker at the door of the furnace will presently have to shovel a trifle harder from the fact that we have that lamp burning, and that represents a certain amount of power which is coming out of the coal. It is perfectly clear, therefore, that keeping a uniform pressure, as shown by the volt meter, of 120 volts, the more current we employ the more work we are having done electrically and the harder that man has to stoke. Similarly, if you have current enough to work one lamp, which is one-half an ampere, as you put on pressure you are going to do more work. If you put the pressure up too much you will burst that lamp. But if you substitute for this lamp a piece of wire that will not burst, and keep the same half ampere through it, but lengthen the wire to suit the half ampere as you increase the pressure, you would have more of the wire carrying a half ampere than before, or you might double the pressure to 240 volts and bring it to bear upon two lamps in series when both would come to candle-power, and each would have half the new pressure, or 120 volts as before, while the current, flowing in series through both, would be half an ampere. We should thus have two lamps burning or twice the heat developed. So you see the work depends not only on the current, but on the pressure as well, and the work done in a given time is found by simply multiplying the two together. If you have one-half an ampere flowing under a pressure of 120 volts, you have 60 units of work being done per second in the lamp, or 60 units of working rate or activity. The unit of working rate is called the watt, after the gentleman who did so much for the steam engine and who invented the horse-power. He desired to establish some unit of work rate, and he thought the horse was the most useful and generally adopted working animal, and he chose a rate of doing work represented by what he supposed a horse could steadily accomplish. It was 33,000 foot pounds per minute. That is, 33,000 pounds raised one foot, or one pound raised 33,000 feet in one minute. But our unit of work is a much simpler one. It is just multiplying the amperes by the volts, and we get in watts the amount of activity that is being developed. With half an ampere and 120 volts, 60 watts of activity come out as heat. Sixty watts mean 60 units of work done a second. It is not the total work, it is the rate of doing work. It corresponds with the rate at which you are doing work when running upstairs. It is 60 units of work, 60 joules being done a second, and a multiplication of the volts by the amperes gives you immediately the amount of energy that is being developed in an electric circuit. So that if you have a motor, for example, and it is taking 120 volts, and it is taking also ten amperes, it is taking 1,200 watts; and in the activity of a standard horse there are 746 watts. So if you want to get in horse-power how much that motor was taking, being 1,200 watts, you only have to divide by 746, and you get something like a horse-power and a half. But, in time, I do not suppose there is any doubt that the horse, just as has been the experience with the trolley system, will be relegated and superannuated to his natural pasture, and we shall cease to speak of standard horses and shall talk of watts. Already to-day, to a great extent, the unit of activity among electrical engineers is the kilowatt which is about a horse-power and a third. It is so easy to see the amount of power delivered to a circuit that to go back to the horse is such an effort that you readily give it up. To give you an idea of a man's capability for physical and mechanical activity, consider the crew of an eight-oared boat in a four mile University boat race. This is as severe a muscular effort directed with scrupulous economy and precision to the object of propulsion, and certainly an effort that no man could undertake effectually without previous training. The speed sustained during the race is about 1,000 feet per minute for twenty-one minutes, and the average propulsive force on the boat approximates seventy-five pounds weight or nine and three-eight pounds weight per oarsman. This corresponds to an activity of 212 watts per man, and the maintenance of this activity for 21 consecutive minutes is sufficient to reduce the muscular system of the contestant to a degree of exhaustion that frequently demands a judicious internal administration of alcoholic stimulant to succor and overcome.

We will show you how this measurement of power is carried out. You have got to take into account both pressure and current. The measurement, therefore, must depend on two factors, not on one factor as heretofore. Here is a diagramatic representation of the plan. This ellipse represents one circular turn of wire standing at an angle like this to you, so that you see it elliptically. The coil is like that. It is a fixed coil which is connected up with two wires in the circuit. There is a smaller coil fitting inside, and it is standing at right angles and suspended by two fine wires, one above and one below. That arrow is a pointer rigidly attached to it. This suspended coil is connected up through resistance with that pressure which is being measured—the coil would be in circuit with 120 volts, say, in this case—and the large outside fixed coil would be connected up with the current that you are going to measure. Now, there will be a magnetic attraction between those two wires so soon as the current flows in both of them. If it flows in one only there is no attraction. But if it flows in both at the same time they begin to act on each other and the tendency is to make the two come parallel instead of standing at right angles to each other as they did in the first instance. The tendency of the magnetic action is to cause the movable coil to twist on the wires that support it and come parallel to the plane of the fixed coil. The greater the current in both coils the greater the attractive or turning force on the suspended coil. If you have one ampere in this and you have two amperes in that, you will have a force on that wire represented by two. But if you double the current in that, you will double the force in the wire and make it four. So the force brought on that wire tending to twist it and making the pointer turn around is represented by the arithmetical product of those two. So putting one to measure amperes directly in the circuit, and the other in such a way that the amount of current will measure volts, their product will be indicated by the amouut of force with which that wire turns.

The other diagram simply represents what happens when the pointer is swung around. You have now the two coils in the same place and the pointer has been turned through 90 degrees. The next diagram represents the application of this plan. Here is a dynamo, a generator. It delivers a pressure of, say, 120 volts. Here are the mains, the wires that correspond to our leads which come into this building. Here you come to this wattmeter, the instrument that measures the power. Here are the two circuits. This is the motor that you are driving your machinery with, and here is the suspended coil circuit, whose resistance is adjusted in manufacture to make the indications of the instrument right. Now there will be no deflection until the current passes through that motor, because, although current passes through that resistance, it does not establish any magnetic attraction until there is current in the fixed coil, too. Here is actually a small portable wattmeter which embodies those features. Here are the terminals on which you connect your pressure, which might be 120 volts. Here you join the supply circuit to the motor, and you determine immediately from the indications of the instrument just what the watts are. That instrument is capable of showing you what your motor can do up to 10 horse-power.

(*To be continued.*)



WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S DIRECT CURRENT ARC LIGHT GENERATOR.

Electrolytic Action of the Return Current of Electric Railways.

George W. Plympton and Frederick R. Lee, the board of commissioners of electric subways for the city of Brooklyn, N. Y., recently rendered a special report to Mayor Schieren regarding the corrosion of water pipes, gas pipes and telephone cables by the return currents from the various electric railway systems of the city. This is given as an appendix to the annual report of the commission submitted on December 15 last. Referring to the subject the commissioners say:

"The experience of Brooklyn is not notably different from that of Boston and Cambridge, Mass., Milwaukee, Wis., Columbus, O., Indianapolis, Ind., and Hamilton, Ont. In each of these cities similar corrosion has been detected, and in none is there any doubt as to the cause. It is known to be due to the imperfections of the means provided by the trolley companies for the conveyance of the electrical current back to the generator. It was at first supposed that the rails would be sufficient, but the current declines to take that route exclusively. The remedy of the evil will have been applied when the trolley companies shall have provided an adequate route for the electric current now discharged into the rails. It was at first reasonably supposed that the rails would afford a sufficient path. Upon the failure of this plan a copper connection to carry the current by the joint was tried. In most cases this expedient failed of complete success, except where the copper bond had unusual dimensions."

The commissioners then give the result of several ways of connecting rail joints by copper wires, etc., continuing as follows:

"A better way to insure the conduction of the current is, doubtless, to make the car rail continuous by welding. This method will be employed on the new trolley line soon to be built in the southern part of the city. The most complete solution of the problem is afforded by the double trolley by which the return current is provided for by an overhead wire similar to the one for the outgoing current. But it is to be hoped that it will not be necessary to resort to this method."

Some notes of experiments obtained through Mr. I. H. Farnham, electrician of the New England Telephone Company, and relating to the early experience in Boston, are then given, the commissioners concluding as follows:

"The conclusions fairly drawn from these notes and from our own experience is that considerable injury is being done to underground pipes and cables, and that it will continue along the lines of the trolley roads (except where the elevated railway extends above them) until better methods of returning the current to the generator are put in practice. The electricians of the several trolley roads are fully aware of the situation and have speedily applied means of prevention in localities where the corrosion had been detected. But it is doubtful if the method of final cure of the difficulty has yet passed the experimental stage."

Westinghouse Direct Current Arc Generator.

The Westinghouse Electric and Manufacturing Company, of Pittsburgh, Pa., have recently introduced the new direct current arc generator illustrated herewith. It belongs to the open coil continuous current class, although there are some radical points of difference between it and other existing dynamos built for arc lighting work. A circular cast-iron yoke, parted horizontally and having inwardly projecting poles, surrounds the armature, which is of the toothed type with lathe wound coils especially heavily insulated. The armature is supported in self-oiling bearings with spherical seat, so that the machines are self-aligning. It has no regulating device or wall traps. Regulation is effected by the reactive effect between the winding of the field and the armature. There are about this machine many other points of interest, one claim made by the manufacturers being especially attractive. They state that this machine has an efficiency of over 90 per cent.

$50,000,000 FOR TELEPHONING.

The American Bell Telephone Company's Argument For Increase of Capital.

EX-GOVERNOR LONG, OF MASSACHUSETTS, ABLY PRESENTS THE REASONS FOR THE INCREASE OF THE BELL COMPANY'S CAPITAL FROM THIRTY TO FIFTY MILLIONS —AN INTERESTING AND INSTRUCTIVE REVIEW OF THE WORK OF THE COMPANY—$31,000,000 SPENT IN THE BUSINESS UP TO 1885 AND $43,000,000 ADDITIONAL SINCE—ABOUT 2,000,000 TELEPHONE CONVERSATIONS A DAY—IF INCREASE IS GRANTED TEN MILLIONS TO BE DEVOTED TO EXTENDING AND PERFECTING THE LONG DISTANCE SYSTEM.

The Committee on Mercantile Affairs, at Boston, Mass., was recently addressed by ex-Governor Long of that State on behalf of the American Bell Telephone Company, which asked the privilege of increasing its present capital of $20,000,000 to $50,000,000. The address is so full of interesting data relating to the telephone business of the United States that we publish it in full. Ex-Governor Long's argument was as follows:

Mr. Chairman and Gentlemen: You wish to be informed on what grounds an increase of the capital stock of the American Bell Telephone Company is asked, what has been done with the capital it already has, and what it proposes to do with the capital which will result from an increase.

The largeness of the sum asked might seem to make it necessary to take a good deal of time in stating these grounds. But they all lie in a nutshell.

It is simply the case of a citizen of this commonwealth, which is doing a large and rapidly increasing business, has reached the limit of its present capital through legitimate and wise expenditure, and now requires additional capital to carry its development on.

It is as if an individual found it necessary to increase his capital because his business is healthily and rapidly increasing. If I may use a homely illustration, it is as when a boy, growing larger and older, arrives at the age at which he needs a larger suit of clothes.

In some States, for instance in New York, it is left to the parents of the child to say when he shall have it. In Massachusetts it is necessary to come to the legislature to ask for leave.

I take it for granted that we are all glad and recognize it as a cause for congratulation when any good enterprise grows. In your town or in mine if a fellow citizen has established a business plant it is regarded as a benefit to the town, so much so that frequently inducements are held out for men to come in and establish such plants, thereby distributing money and encouraging the employment of labor.

It is a cause of additional congratulation if its business increase so that more money is put into it, a larger product obtained, more taxable property gained in the town, more men are employed, more money in the banks and in circulation, and the industry constantly enlarging.

The same is true, I take it, with regard to the State. If any corporation, the creature of the State, engaged in a large, flourishing, creditable business, is increasing its business, is employing more labor, is accumulating more property to be taxed, it is a benefit to the whole community.

Corporations with a large amount of capital are not unusual. The capital of the Western Union is some $94,000,000; there are half a dozen companies that range all the way from $30,000,000 to $35,000,000; the capital of one of the refining companies is $75,000,000. It is a mere question of the amount of capital necessary to carry on the business. Mr. Moriarty, of your committee, will remember that two years ago I came here and asked for an increase of the capital of one of our large rubber companies.

Its president, when he put the case in my hands, said, "We have a million of capital now, which is the maximum amount allowed by the general statute. But our business has grown beyond all expectation. It is necessary for us to have our capital increased to $5,000,000. Competition has arisen in neighboring States, and we must have that increase, and we have the funds to invest to that extent. Present that simple fact to the committee, and, if on the strength of it, they increase our capital, well and good; if not, we must go elsewhere, where we can have that privilege."

I followed the instruction. The only witness I put upon the stand—and the hearing did not take half an hour—was the president himself, who told the committee the growth of the business of the company, the amount of property they had on hand, and the competition to which they were exposed from companies in neighboring States.

The committee immediately assented. A bill was reported. The capital was increased, and the company has been going on since with its enlarged resources. It was an admirable consummation for the company and the commonwealth. The taxable property of the commonwealth was increased, and more labor has been employed.

It was the case of an honest enterprise whose business had grown, and which, if it had been a private citizen or had been incorporated in New York, could have had its capital increased at its own will, but which here had it increased by permission of the legislature.

The telephone is the most wonderful discovery of this half of the century. It is unnecessary for me in any way to dilate upon that fact. No invention for that period will compare with it in magnitude, in extent, and in the largeness of the business which it immediately began to do, and which hereafter it will continue to do.

At first, as you all remember, it was a string with a piece of flat metal at either end. It then developed into a means of local communication, speaking from house to house or from street to street. Very soon its larger capabilities were seen, though many were doubtful with regard to its ultimate perfection or value.

In 1880, however, such was the recognition of the greatness of this discovery and of its possibilities for commercial and social benefits that application was made to the legislature for a charter, and a charter was granted.

The legislature recognized, even at that time, the unusual value of the invention by incorporating the company with $10,000,000 capital, which was 10 times the amount allowed by the general statutes. That charter provided not merely for the incorporation of the company, but also, to a certain extent, the manner in which it should do its business.

It provided that it might do it directly, or carry it on through local companies or organized in this and other States throughout the Union, which were its licensees, and might take stock in such companies to the extent of 30 per cent. of their capital.

These local companies cover the whole length and breadth of the United States, the whole 48 or 49 present States in the Union; and the American Bell Telephone Company is doing business directly and also through those companies, its licensees.

To-day this corporation, which Massachusetts created, which is a child of the commonwealth, and which in every way has shown itself worthy of its parentage, is doing a work that embraces the whole Union, and is bringing all the people of the United States, or will soon bring them, within speaking distance of one another.

From year to year, after the incorporation of 1880, the company went on developing its connections, enlarging its plant, discovering new methods of carrying on its work, at the same time creating a demand and supplying and meeting the demand, so that in 1889 it came here again, showed what it had done with its capital, what its business was, what the prospects for the future were, and asked for an increase.

In response, its capital was doubled, making the capital $20,000,000. That, of course, does not bind any succeeding legislature, but it does establish the fact that your predecessors and the general court of this commonwealth—and there never has been any criticism upon its action—recognized in 1889 that this was a company which was using its resources properly, that its business had increased so that in the short space of nine years it was necessary to double its capital. There are two periods in the history of this company, the first period, extending from the time of the invention, including the corporation of 1880 and running up to 1885.

On the first day of January 1885, the company, in itself and through its licensees, had expended the sum of $31,000,000. That amount had been expended for materials and for labor; a great corporation has been made subject to your taxation, and was aiding in what is the real solution of the great present question of political economy—the distribution of the wealth of the world.

Let me say that up to this date had been the experimental period, and while every dollar of this money had been spent judiciously and wisely at the time, some of it had, of course, gone in the experimental way.

As always happens in the elementary stage of a great invention, new inventions were made, old ones were worn out and discarded, and some of the expenditures were less valuable than would be the case now under a condition of things when the invention is established and its scientific features are settled and clear.

That expenditure of $31,000,000 was, however, one of the facts which were before the legislature in 1889, and you may take it for granted, I think, certainly in view of the fact that the increase of the capital was then allowed, and no criticism followed, that the legislature of that year was satisfied that the expenditure had been justified, and that it was necessary there should be an increase of capital.

What have we been doing since 1885? I will give these things to you rapidly.

Since January 1, 1885, this company, through itself and its licensees, has expended $14,500,000 in the one item of subways and the cables contained in them, over $10,000,000 for subways or conduits underground, and over $4,000,000 for cables; that is, these great wires, which are woven together and run underground. Let me ask your attention one moment to this matter of subways.

It was early found that there might be some intricacy of wires. You have wires for street cars and wires for electric lighting in addition to these wires for telephones.

To-day you are considering the question of putting all wires under ground. Let me remind you that the Bell Telephone Company, without legislative suggestion, without compulsion from the legislature, but carrying its original and constant purpose of an honest, true development, itself initiated the system of subways. It has spent since January 1, 1885, $14,500,000 in that one item, in addition to all previous expenditures.

Next, a subway running through a great city terminates somewhere. It comes up to the top of the ground. It must enter a building. You can see at once that it is desirable that the company should not have their subway, which had been constructed at this enormous expense, come up in a building which they rent, which belongs to some one else, and which they may have to part with.

Therefore, in the development of this great enterprise, it was soon apparent that it is necessary for the company to own their buildings. They have erected them in the various cities.

They have one in Boston, on Milk street, on which they are paying taxes. It cost nearly $1,000,000. They have erected buildings in New York and in other cities.

In the one item of real estate, since January 1, 1885, they have expended $5,884,400—call it $6,000,000, which is probably the sum to-day. Thus $6,000,000 more has gone into real estate, and the most substantial kind of property.

That money has been expended in materials and labor, and has gone into the great work of the distribution of the wealth of the world.

Next is the aerial equipment and exchange. The wires are not all underground, and cannot all be underground. Part of the work is still above ground. In the matter of overhead or aerial equipment and exchange there has been expended since January 1, 1885, $12,349,000—calbit $12,500,000—for it is probably that by this time, as the work is going on continually.

Now you come to what is, perhaps, the most interesting and the most important part of the work and development of this invention, the one which strikes the imagination with the most force, and that is the development of the long-distance telephone. The long-distance telephone runs wide over the country, and is entirely controlled and paid for by the American Bell.

It was a somewhat hazardous experiment, but just as soon as we began to talk from here to Lowell, and from here to Worcester, somebody said, "Why not talk to New York?"

The effort was made, and the line was established to that city, first working imperfectly, to-day working so well that you can talk with a man in New York as I talk to you across this table. Then came the line to Philadelphia and other cities.

Then came the desire at once to reach what is nowadays the center of the universe, and that is Chicago. It requires some courage and some faith (I ask you to bear that in mind) to start that enterprise, and to ask people to put their money into the attempt to establish talking with Chicago and at such long distances. But the attempt was made, and to-day there is a perfect system of telephonic communication with that city.

What does that mean? It means 1,200 miles of copper wire from New York to Chicago. This wire is copper, one-sixth of an inch in diameter, weighing 435 pounds to the mile. One circuit to Chicago—that is, a wire there and back—takes 1,044,000 pounds of copper wire.

This long distance system is still, of course, in its early infancy. It has been established for only two or three years. I cannot give you the exact date, but it is f very brief establishment.

There have already been put into it and other toll lines an expenditure of $10,000,000. The exact amount up to January 1 last was $9,165,541, but it is probably $10,000,000 to-day.

When anybody says, "I can buy a telephone for $2," let me suggest this to you: When you put that telephone to your ear, you are holding in your hand not merely a little piece of wood worth $2, but you are holding in your hand and are in touch with millions and millions of dollars of property for which honest money has been paid, which furnishes the foundation for additional taxation, and which has aided in the distribution of the world's wealth by the purchase of material and the employment of labor.

Stand in New York city, and you can talk with a man in Boston to the East, in Chicago or Milwaukee to the West, in Buffalo to the North, in Washington to the South. In other words, you are covering by the sound of your voice an area which contains half the people of the United States.

Consider what that means, and what the nature of the enterprise is which puts half the people of the United States in speech with one another.

Of course, the long distance system must be extended, and preparations are already made toward extending it. You must extend to Kansas City. You must extend to Omaha. You must ultimately reach San Francisco. You must go down largely into these developing Southern States, cities like Atlanta and Galveston and New Orleans, and still farther East and still further North.

Does any person in this committee suppose for one moment that an enterprise which has gone as far as this has gone is going to stop; that you are going to stop at Washington, go no farther South; that you are going to stop at Chicago, go no farther West; that you are going to stop at Buffalo, go no farther North?

No, the natural and business development is to increase the facilities which are already established, but only established in their infancy.

Foot up these sums. Since January 1, 1885, there has been spent in hard cash, for real estate—I will give round figures—$6,000,000; overhead equipment and exchange, $12,500,000; underground subway, conduits and cables in them, $14,500,000; long distance and toll lines, $10,000,000. These make something like $43,000,000 which has been spent since 1885.

Add the $31,000,000 spent before 1885 and you have an expenditure in the neighborhood of $75,000,000, to which the commonwealth has never been asked to contribute a penny.

There is an impression sometimes abroad that when a corporation asks for an increase of capital it is asking the commonwealth for an appropriation. Of course, it is not so.

The Bell Telephone Company simply asks the commonwealth to give those who have developed this great enterprise so greatly an opportunity to carry the development farther.

How has that $75,000,000 been raised? This company alone had a capital of $20,000,000. The various companies of the stock of which it is allowed to take a certain per cent. had their capital. Something has also been derived from the income and the receipts, a part of which has been appropriated to construction, and some portion has been raised upon loan.

The Bell Telephone Company is the parent company, the source and spring, a Massachusetts company. Under its lead these great expenditures have been made.

It is not suggested that any part of them has been used except for the purposes of the legitimate development of the enterprise. Nobody complains because the capital was $10,000,000 in 1880, or because it was increased in 1889 to $20,000,000.

The natural order of things, without saying anything more, would satisfy the committee that, having started with $10,000,000, having doubled that in nine years, the time has come in the natural growth of so large a plant for another doubling. But we go further and give you the exact figure, so that you may see that the necessity has actually arisen.

In other words, it is the case again of the individual whose business has expanded and grown and who needs more capital.

Let me add that the company stands committed to the expenditure right away of $10,000,000 more to perfect its existing plans in the long-distance line, to say nothing of further needs.

As I say, there must be an immediate extension of the system still farther West and still farther South, to the great cities of the neighboring country.

Let me give you one or two illustrations of our growth.

For instance, in 1881, the year after the first charter was granted, the number of miles of wire in use for telephonic purposes on January 1, was 29,714; on January 1, 1894, it was 488,521, more than 15 times as large. Is that the end? Ask yourself. Is that all, or is more going to be expended?

Take the number of miles of underground wire. That did not begin until 1885. Without legislative compulsion, of its own motion, the company then began to establish subways, and on January 1, 1885, there were in use 1,225 miles of underground wire; on January 1, 1894, 115,000. In other words, about a quarter of all the miles of wire have been put underground since 1885.

Is that work going to stop? Is that the end of it, or is it going on? If it is going on, is not money necessary?

Take the number of telephones in use. Starting with 5,000, to-day there are 566,491—more than 100 times as many. Is that going to stop?

How many people are supplied with telephones, numerous as they are to-day, val-

uable as they are in performing the business of your office? Is this use going to stop, or is it going on, going to increase?

If it is going to increase, is not more capital necessary? If it is, and it is a good business which is developed, shall the company have the capital, or shall they be told they cannot have it, and if they want more capital they must either shut up shop or go to some State that will let them have it.

Take the number of telephone subscribers. In 1881, the year after the incorporation of the company, 47,800; to-day, 237,000.

Another interesting table is this—the number of talks. It is interesting for you to know how far people are using the telephone as a means of communication with one another. In 1884 there were 215,000,000 talks over the telephone. In 1893 there were 600,000,000 talks; in 1894, 650,000,000. That is nearly 2,000,000 talks a day. One has to stop and deliberate to get into his mind such a sum.

How many messages are sent over the telegraph lines? My memory is that there are about 63,000,000, and the telegraph has been developed a great many years. On the other hand, telephone communication is in its infancy, and yet your telegraphic messages during the year are 60,000,000, while your telephonic messages are 650,000,000.

To subscribers that has amounted to from two to 11 cents for each message. You pay 30 cents for a talk, say, to and from Haverhill or Worcester, or even $2 from here to New York; but to telephonic subscribers the average has amounted, on the average, to from two to 11 cents for each talk. And you are not limited to 10 words.

You have two or three minutes' talk, and you know how much you can do in a very few minutes, unless you are unfortunate enough to be addressing a committee and taking more time than you ought. In other words, the cost is reduced toward the cost of the United States mail.

The number of persons employed will interest you; that has increased, so that to day there are over 10,000 persons employed.

At the building where we shall go in a few minutes, I desire to show not only the beginning of the subway and these enormous cables, but to call your attention to some details which are suggestive of the magnitude of the whole thing.

Take, for instance, the switchboard. In the city of New York, one switchboard is 264 feet long, at which sit the operators. Each operator attends to perhaps 50 subscribers. There are 10,000 subscribers in the city of New York. Any one of them, by ringing his bell and calling up the central office, can be put into communication with the other 10,000.

Gentlemen, think for one moment what this system already enables us to do. You will bear, as you hear with regard to other enterprises—I think less here than usual—complaint as to some little detail here or there; but is there, do you feel, do you know, that there is in the community any real or general restiveness under the existence of the telephone company?

Is it not recognized as a great, a very great invention, and a matter of inestimable commercial and business convenience and value? You can communicate with any part of the city, with any part of the State, and soon with any part of the United States.

You send for your doctor and communicate with your lawyer. You communicate with your business partner. Your wife orders her groceries and talks with her friends.

One might—I shall not, for you want facts—one might be eloquent, and go to great length in describing what the utility of the invention is, the greatest invention of the age, and the greatest aid possible to commercial enterprise and the transaction of business since the railroad.

A man will growl, perhaps, because he has to pay 25 cents for a telegraphic message, because he has to pay 25 cents for a telephonic message, or whatever the sum may be; and yet, ask him whether it is not of advantage that, staying in his home 30 or 40 miles away, he has been able to communicate with Boston and perform an important piece of business, and thus save the expense of travel and the loss of a day's time, and he will answer at once that the advantage is worth everything to him.

I do not know that it is necessary to say anything here in regard to rates or matters which are covered by bills pending before other committees. The only question here is the increase of capital.

It may, however, be said that there will always be at first an increase of expense while you are carrying an invention to its perfection.

I can remember the day when, in the country, we had a tin kitchen for roasting meats before the open fire. Afterward the same tinman who sold the tin kitchen sold a stove. The stove cost more than the tin kitchen, but we preferred it, because it gave infinitely better service. When the stove was brought to the perfection of its development, the price began gradually to fall.

I do not think that there is a large or general complaint of rates. The rate of a telephone put into my office to-day is the same as it was some years ago, if I content myself with the same telephone. If I have one of the perfected machines it is more. I have forgotten how much. But nobody is willing to give up the new machine for the old one.

But whenever the development comes to its full, whenever the system is complete, especially with competition — and you already have before you the petitions of other companies desiring to be incorporated, to which we make no objection—then, when the work is perfected, the rate, of course, will come down.

Let me turn back and ask you to recognize the courage and faith of the men who have put their money into this enterprise. Men of the highest character in this community—and there are no men of higher character in the community than the directors of this company—propose to ask their fellow-citizens to put hard cash into this further development. Yes, hard cash.

By the way, the question was asked me by somebody whether the increase of capital asked for was to be put in in cash. Certainly. You may require, if you wish, that it be paid in gold eagles.

If there was ever a genuine, honest matter before you, it is this. We ask to increase our capital by putting in cash—hard cash, nothing else—which shall be expended, as I said, for material, for labor, for the employment of the unemployed, and the development of one of the great inventions of the age.

The element of courage and faith is still necessary. Here is a corporation that has been paying in the neighborhood of 15 per cent. dividends. If the public were certain of its success, if there were still no element of risk or of danger, nothing calling for courage and faith, that stock would be worth on the market 300 per cent. What is it selling for? 170.

Mr. Hudson, the president of the company (who is here), a few years ago, as I told you, only two or three years ago, had his mind called to the conception of extending telephonic communication long distances, communicating and connecting with Chicago.

Do you not think it required some courage on his part, some weight of character to call upon his company to take that step? But it was taken and it has been justified. Such enterprise should be encouraged by the legislature.

Who are the stockholders of this company? There are 200,000 shares of stock. There are 5,277 stockholders, and of these 3,721 are stockholders who have holdings of less than 25 shares each; in other words, three-quarters of the stockholders in this great company have less than 25 shares each.

What does this mean? That the stock is distributed largely through the community. It is held in trust. Widows hold it. Are those the people to be encouraged?

Who are the directors? The president is Mr. John E. Hudson, who sits here, a man of the highest repute and standing. Associated with him on the board of direction are such men as Charles P. Bowditch, Alexander Cochrane, William H. Forbes, Gardner Hubbard, Charles E. Perkins and others. Mr. Driver is the treasurer. All these men live in Boston. It is a Massachusetts enterprise. It is a Massachusetts concern. It is a great big business here which looks to Massachusetts as its parent. It is something in which the State should take pride. It is not a question of some questionable scheme coming to you and showing you a record to be investigated; it is a company with a good record, a company that has spent honest money, and asks to spend more, because its business warrants it.

I said a moment ago that it asks nothing from the State. It seems incredible that such an idea should go abroad, and yet I think there is among a great many people in the community an impression that when a corporation asks to increase its capital it asks something from the State.

Of course I need not say to the committee that no money is asked from the State. On the contrary, all we ask of the State is the permission to invest our money, to ask our friends to put their money into an enterprise which has justified itself.

We are asking the State to do something for its own advantage. The corporation is paying into the State treasury $150,000 a year in the way of taxes—I think the exact amount is about $147,000—call it $150,000, and we ask to increase our capital which, of course, will result in an increase of taxation.

We ask you to retain this corporation in Massachusetts, that its headquarters shall be here, that its employment of a clerical force and of operatives shall be here, so that Massachusetts shall get the benefit of having its citizens employed, its supplies furnished from Massachusetts sources.

Wherever the headquarters are there naturally the supplies are sought. Do not forget that such a company keeps its funds here, deposits in our banks and pays out its dividends over Boston counters.

Mr. Hudson came to me in the early part of the session and said that he desired me to ask for an increase of capital. He said that the amount ought to be raised to $50,000,000, and showed me the figures I have given you. I advised him to ask for exactly the amount, squarely and straightforwardly, no more and no less.

When he showed me these figures, showed what had been put into subways, what had been put into aerial equipment, what had been put into real estate, what had been done in long-distance construction, and yet he had only reached Chicago and Milwaukee in the West, and only reached Washington on the South, I said at once, "Ask for an increase to $50,000,000."

"The committee will wish to know, first, what have you done with the money you have had? What do you propose to do with the money that you ask for? And the minute you satisfy them that you can use $30,000,000 properly in further development from time to time, I am sure they will grant it."

I believe, gentlemen, that I have covered all that I need to say. I will assure you again that it is simply the honest request of an honest corporation, dealing with the largest enterprise of the age, to do what any business man would do, what any of you would do, and that is make your capital correspond to your necessities.

It is idle to come to ask for $10,000,000 now, then in 1898 come again and ask for $10,000,000 more, and in 1902 for $10,000,000 more.

Is it not plain that the company must have more capital? Is it not plain to everybody here that, with these figures, they are going to have more capital? Is it not plain that it is to the advantage of this State that they should have more capital?

Suppose you refuse their petition! Must they stop? Would you, if you were the company, stop? No.

If you refuse to give them an increase of the capital stock you say to them, whatever your reasons may be, "We refuse to give you this increase of capital stock. You have, indeed, well spent your money, you need more, your development is going on, but we are not going to give you the means to accomplish it." In other words, you say, "Surrender your charter. Go to New York, where the amount of capital is unlimited, and increase your capital there as much as you please."

I am not going into the question whether it is desirable to have the law as we have it in Massachusetts, and that is, allow no corporation to fix its own capital.

I am inclined to think that the New York law is wiser; that it is always better to let a company say how much capital it requires, but to have your legislation such that it shall be a proper restriction upon the use of the capital after it is once in.

We, in Massachusetts, have not adopted that system. We say, "If your business increases, we will, when the time comes, permit an increase of capital."

One of three things is necessary. Either this capital must be increased, or the company must stop with its work only half developed, or you compel them to surrender their Massachusetts charter and go where they can get a charter which will allow them the capital they need.

The General Electric Company has just removed its works from Lynn to New York. Is it not wise to encourage our corporations to stay within the State?

"Arc Lights on Incandescent Circuits."

BY L. B. MARKS, BEFORE THE WASHINGTON CONVENTION, NATIONAL ELECTRIC LIGHT ASSOCIATION.

The record of inventions in electric arc lamps during the last few years has shown that the trend of development has been in the direction of their application to incandescent circuits.

As far as the underlying principle of operation is concered, it may be said that the various types of arc lamps for constant potential circuits are practically the same. The differences are mainly in details.

While the introduction on direct-current incandescent circuits has been accomplished with a fair degree of success, the waste of a large percentage of energy in "dead" resistance is always involved. With a single arc across such a circuit the loss of energy due to resistance in series may be from 50 to 60 per cent; with two arcs in series across the mains the loss may be reduced to about 25 per cent. On 110 or 120 volt circuits economical conditions require more than one arc lamp across the mains.

The performance of a pair of lamps connected in series on a constant potential circuit proves the conclusion which may be arrived at from a theoretical study of the conditions: First, that it is impossible to maintain a constant current through the arc branch; second, that it is necessary to insert a wasteful resistance of some magnitude in the arc branch to secure even fair results.

In his admirable paper on "The Electric Arc and its Use in Lighting," read at the National Electric Light Association Convention, February, 1891, Professor Elihu Thomson, alluding to the application of arc lights to constant potential circuits, says: "A great deal of useless experimenting has been, and, probably, is yet, carried on with the vain endeavor of getting rid of the resistance or choking coil in this case, but the difficulty is inherent in the nature of the arc, the relation of resistance to current giving rise to instability of the current in the arc."

During the past few months Mr. C. Ramson and myself have been engaged in the development of what we believe to be an entirely new idea in arc lighting. I refer to what we have called the *high potential incandescent arc*. I have found that when the electric arc plays in an atmosphere of CO gas, the usual relation of current, potential difference and maximum efficiency of an electrode of given diameter does not hold.

By confining the arc in a very small bulb, filled with carbon gas, we have been able to efficiently reduce the current and greatly increase the potential difference. For instance, with a pair of electrodes which in the open air arc light give a maximum efficiency at nine amperes and 50 volts, we have obtained excellent results at four and one half amperes and 100 volts, a condition impossible in open air arcs.

We have had no difficulty in running 100 to 120 volt arcs in this way, the current in each case being very small. The bulb we have used for this purpose is a modified Howard cylinder, containing a special device for controlling the inclosed gas.

When operated under these conditions, the arc is about half an inch long and very steady. The violet hue so common to open air long arcs is not marked, the quality of the light being especially valuable for indoor illumination. The life of a pair of $\frac{7}{16}$ inch carbons in a 500 watt lamp is about 100 hours.

The application of this system to incandescent circuits and its advantages over the present method are apparent. It dispenses with the necessity of running two lamps in series, a single arc without appreciable dead resistance being sufficient to bridge the mains.

It will be noted that the consumption of carbon is so slow, that even if the points are fixed the potential difference between the electrodes will not increase more than a few volts per hour. The comparatively rapid consumption of carbon in open air, and the consequent changes in resistance and candle-power of the arc, are in marked contrast to the above, and suggest an important advantage of the inclosed arc for constant potential circuits.

In the method just described the two elements whose product equals the consumption of energy in the circuit are susceptible of a wide range of variation, and may be adjusted to suit the conditions, just as the primary and secondary coils of a converter allow of great flexibility.

With a potential difference of 115 volts between the carbon points and a current of four amperes, a single lamp consumes 480 watts on a 120 volt incandescent circuit, the amount of energy expended in the arc itself being 460 watts. The loss equals 20 watts per lamp, or 40 watts for two arcs, each directly across the mains.

Comparing these figures with the data obtained from existing conditions, we note that under the most favorable circumstances the loss of energy for two open air arcs, each 460 watts, across 120 volt circuit, is 280 watts as against 40 watts in the first case. Thus there is a clear saving of about 20 per cent. in energy accruing from the use of the high potential lamp. I shall not consider the case of a single open air arc across the mains, such an arrangement being extremely wasteful of energy.

In the lamp which we have constructed for our purpose we have two regulating coils differentially wound on the same core, and in series relation to each other, one coil being in series with the other in shunt around the arc. By properly proportioning the coils we have obtained a very sensitive feed.

Summarizing, the advantages which may accrue from the use of the high potential lamp on incandescent circuits are as follows: (*a*). Saving in energy; (*b*). Saving in cost of trimming; (*c*). Saving in carbons; (*d*). Improvement in the quality of the light; (*e*). Sub division of the light; (*f*). Cleanliness; no carbon dust or soot; (*g*). Perfect spark arrester.

Notice the announcement of Queen & Company, Philadelphia, and send for catalogue "T."

The Rhode Island Tool Company, Providence, R. I., is getting the cream of the orders placed for drop forged nuts, bolts, wrenches, etc., for the electrical trade.

The Iron Work for the extension to the E. W. Bliss & Company foundry building, at Brooklyn, N. Y., will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn.

Ball & Wood, engine builders, New York, have met with much success in the electric lighting and electric railway fields. Their new direct-connected engine will soon be announced.

The Bryant Electric Company, Bridgeport, Conn., is sending out from its Chicago office neat little circulars giving particulars of a few of the well-known Bryant specialties.

The Calumet and Hecla Mining Company, have placed the order for a new iron building with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 40 feet wide and 125 feet long, covered on the roof and sides with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron.

Ward Arc Lamps were never so cheap. The bargain sale announced on another page is a real one. If any reader of the ELECTRICAL REVIEW needs arc lamps for incandescent circuits, let him write to the Electric Construction and Supply Company, 18 Cortlandt street, New York, and give his idea of prices. He will be met on a fair basis.

The Babcock & Wilcox Company, boiler manufacturers, recently moved to more convenient quarters at 29 Cortlandt street, N. Y. The immense business of this company can now be handled with less wear and tear to the mind of General Manager Pratt, who with his two almost as handsome engineering associates form a trinity of graces never excelled and seldom equaled.

The H. W. Johns Manufacturing Company, 87 Maiden Lane, New York, has in preparation a new list of its well-known trolley line insulators which will be ready for delivery in a few days. The list will contain illustrations and descriptions of several new pieces which have just been brought out. Prices have been revised and in some instances are appreciably lower than heretofore.

Queen & Company, Philadelphia, are having a large demand for their Acme portable testing set, which is the most compact thing of its kind on the market. For the rapid measurement of resistance it is claimed to be the nonpareil. The demand for magnetic vane ammeters and voltmeters would seem to indicate a very pronounced revival of business among the dynamo and motor manufacturers.

The Goubert Manufacturing Company, sole makers of the Goubert feed water heaters, Stratton separators and Goubert surface condensers, have removed their offices from 32 Cortlandt street to 14 and 16 Church street, corner of Cortlandt, New York city, where they have large and commodious quarters provided with every facility for the rapid and convenient handling of their large and growing business.

The Central Electric Company, Chicago, report a larger demand for the new iron armored interior conduit which has been brought out to meet the requirements of a higher grade of construction. Their first order was given by Mr. G. W. Furbeck, 1,161 Monadnock building, Chicago, who will use it for the wiring of the new West Side tunnel. The presence of a large amount of moisture renders the use of a high insulating medium imperative, and this new type of conduit meets all of the exacting requirements.

The Pole Age.—This is an age of poles. Our streets are encumbered with all kinds and conditions of poles, sightly and unsightly. It is gratifying to know that the old-fashioned ones are fast becoming obsolete, and this is accounted for by the fact that several concerns have foreseen the necessity of a reform along these lines. Morris, Tasker & Company, of Philadelphia, have been abreast of the times in this reform movement, and are now manufacturing an iron pole for the support of wires for electric lights and electric railways that will overcome the present prejudice that is caused mostly by the unsightly appearance of the rough wooden poles now in use. This should interest prospective purchasers.

The Metropolitan Electric Company, Chicago, are getting in a stock of porcelain floor tubing of all sizes, to meet the requirements of the Board of Underwriters. This company is pleased to note that the dynamo and motor makers are using P. & B. armature varnish with satisfactory results, larger companies buying in barrel lots. The Metropolitan Company carries a full stock of the P. & B. specialties and makes shipments to the entire satisfaction of their customers. The Xentric switch handled by the Metropolitan Electric Company is not as generally known as some other switches on the market, but where it has been introduced it is said by practical men to be superior. It is the latest improved device in switches, and is made by that well-known switch manufacturer, Mr. H. T. Paiste; the Metropolitan Electric Company handling his specialties.

Westinghouse, Church, Kerr & Company.

After continuously occupying for 10 years offices on the ground floor of 17 Cortlandt street, New York, the firm of Westinghouse, Church, Kerr & Company have removed to the Havemeyer Building, 26 Cortlandt street, where they now occupy a suite of four large connecting rooms and a private hall on the sixth floor. Just at this time it seems proper to look back over the past of this firm, whose name has achieved a hitherto unapproached reputation for honesty, ability, conservative progressiveness and the fullest success.

To a large extent Westinghouse, Church, Kerr & Company have been and are original as to methods and principles, both in engineering and business matters. The correctness of their ideas is fully demonstrated in the fact that no matter how dull the times they are always busy. Their chief characteristic seems to be doing things that have never been done before, and so little are they acquainted with failure that the firm has always done a profitable business.

The diversified talents of the men composing this firm have led them to explore and advance the interests of many lines of engineering. Westinghouse, Church, Kerr & Company have been intimately connected with the development of the Westinghouse engine, the invention of Mr. H. H. Westinghouse, from the small simple form to the large compound type. They were the earliest and strongest advocates of the interests of sub-divided power. They have been leaders in the development of the mechanical stoking of coal and in the utilization of mechanical exhaust draught. They took up the "steam loop" when it was regarded as a mechanical paradox, and have extended its merits in more than a thousand systems. Their latest special extension in engineering is in refrigeration and ice-making, for which they have perfected a system that can be used very profitably in conjunction with electric light and power plants.

The ELECTRICAL REVIEW is pleased to remind its readers of a few of the merits and achievements of this old reliable engineering firm, and to express the hope that success may be many times multiplied in the next 10 years of its existence.

Consolidated Electric Storage Company —A Reply from President Bracken.

TO THE EDITOR OF ELECTRICAL REVIEW:

I have read the letter of Mr. Gibbs, president of the Electric Storage Battery Company, in your issue of this week.

Feeling that yourself and the public may be interested in getting the true facts in relation to the decision by the Court of Appeals in France sustaining the Faure patent, I ask to be permitted to once more trespass on your space in order to make clear what Mr. Gibbs endeavors to befog by the most specious casuistry, by stating that the price which Baron Rothschild paid for the French Faure patent was merely a "nominal consideration," and, secondly, by endeavoring to make the reader of his letter think that the decision in France did not affect his battery. Now, the fact is, that the decision in France was directly to the point that the chloride battery is an infringement of the Faure patent, and that the force of that decision was so strong against the Chloride company, that Baron Rothschild had to buy a controlling interest in the Faure company, paying therefor 1,350,000 francs besides the debts of the Faure company. This sum may appear to Mr. Gibbs, whose company is capitalized at $10,000,000, as a "nominal consideration."

The battery which was enjoined by the French decision is substantially similar to the chloride accumulator, and in *no way* resembles the description which Mr. Gibbs' fancy attaches to it. It was the Pollak battery. To a lead support was applied sulphate of lead and chloride of sodium; Mr. Gibbs' company applies to a lead support chloride of lead and chloride of zinc. Pollak immersed his plate in a bath of chloride of sodium, containing a slab of metallic zinc, for the purpose of reducing the matter adapted to become active to spongy lead; Mr. Gibbs immerses his plate in a bath of chloride of zinc, in connection with a slab of metallic zinc, in order to reduce the matter adapted to become active to spongy lead; so that we have in each case salts of lead applied to a lead support, in each case immersed in an equivalent bath with a metallic zinc slab, for the same purpose, to wit, to reduce the active matter to spongy lead. The Court of Appeals of France held that the Faure invention covered salts of lead, as well as oxide of lead, and that Pollak could not escape infringement by the double process above described. The court says that the first process was but a preparation of the plates, and the moment the two plates were combined in the acidulated electrolyte, Pollak became an infringer of the Faure invention.

A copy of the decision can be seen at my office; also my authority for the payment of what Mr. Gibbs calls the "nominal consideration." Yours truly,

WM. BRACKEN,
President.

New York, March 9, 1894.

WESTERN NOTES.

Mr. W. S. Monroe, of the mechanical department of the World's Fair, has in preparation an excellent paper reviewing the work of the electrical and mechanical departments.

The Co-operative Electric Light Company has given a trust deed for $40,000, running for 10 years at six per cent., to the Royal Trust Company, secured by the company's plant on the old Ogden property on North Clark street, in the rear of the Newberry Library.

The Western Society of Engineers enjoyed a dinner at the Grand Pacific the other evening, after which the members listened to an instructive paper by Mr. Charles J. Roney, entitled "Some Notes on the German Collective Exhibit of Engineering at the World's Columbian Exposition."

Motor Cars.—There is every indication that several hundred motor cars will be purchased for use on new Chicago roads before the year closes. The prospect for electric railway work in this section is so promising that several eastern manufacturers of railway supplies are considering the advisability of opening a Chicago office, and new manufacturers' agents are coming up like a crop of mushrooms.

The Edison-Sault Electric Company has prepared an estimate showing the cost of lighting Hay Lake channel by a system of 56 electric buoys, arranged 28 on each side of the channel and capped with incandescent lamps. If the plan is feasible it may result in a saving of 10 miles in distance. Mr. G. W. Furbeck, the contracting engineer, 1,161 Monadnock building, is using the new iron armored interior conduit in wiring the West Side tunnel under the Chicago River, the excessive moisture rendering a high insulating medium imperative. F. DE L.

Chicago, March 17.

The Favorite Route Between New York and the East.

For many years the Providence Line and the Stonington Line, though operated under one management, have used different piers in New York. On December 1 last, however, Providence Line Pier 29, N. R., New York, was given up, in order to permit the city to widen the street at that place, and hereafter both lines will use New Pier 36 North River, foot of Spring street, and one block above Canal street, which has been the pier of the Stonington Line for some years. Pier 36 is being greatly enlarged to accommodate both lines, and new ticket offices, waiting rooms, baggage rooms, etc., are being built, which will be fitted up with all modern improvements, and which will enable the company to accommodate the passengers of both lines in buying tickets, checking baggage, etc., in the most complete manner. Comfortable waiting rooms for the use of friends of passengers waiting for steamers to arrive, etc., will be provided. The external appearance of New Pier 36, when the alterations are completed, will be very handsome, and it is safe to say that it will be one of the finest piers in every way on the river front. The Providence Line will resume passenger service from above pier on May 7.

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